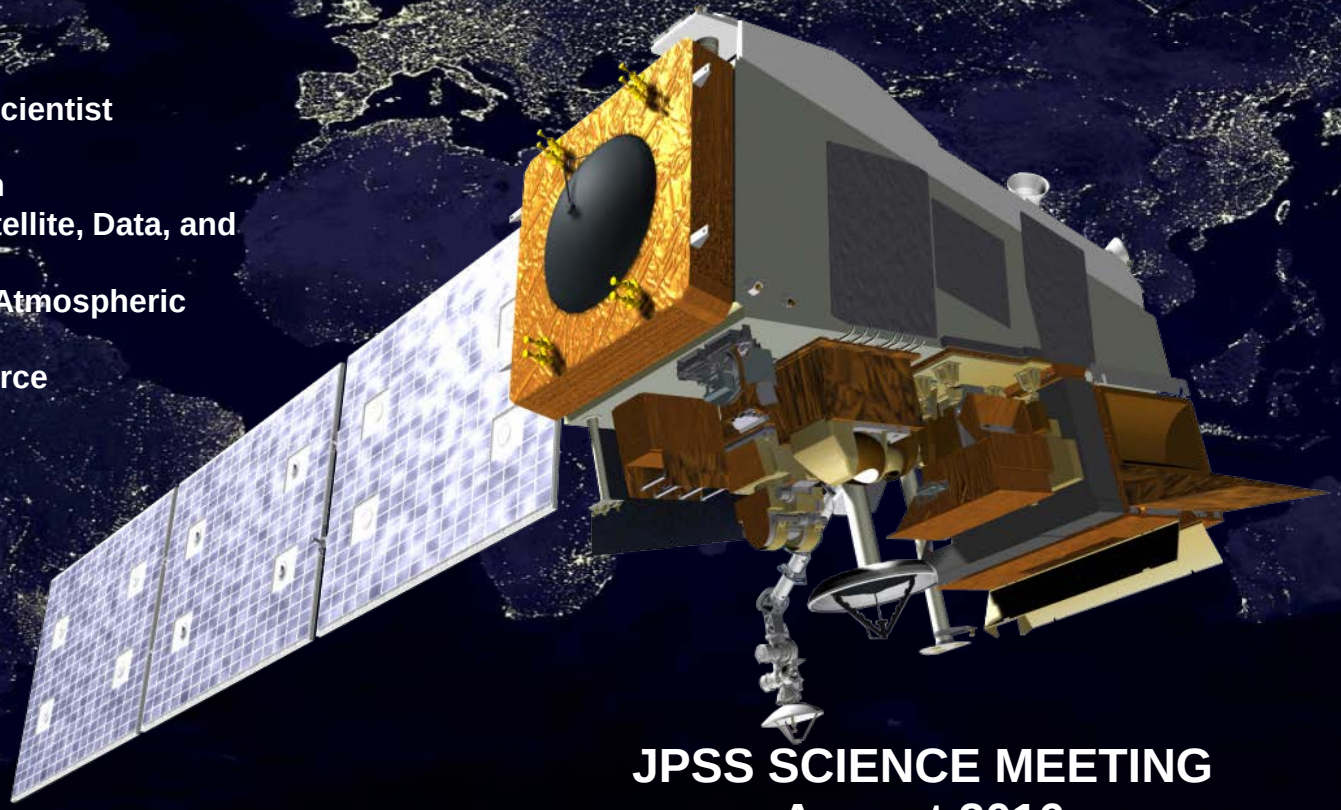
Joint Polar Satellite System (JPSS)

The NOAA JPSS Program and Applications

Mitch Goldberg, Program Scientist

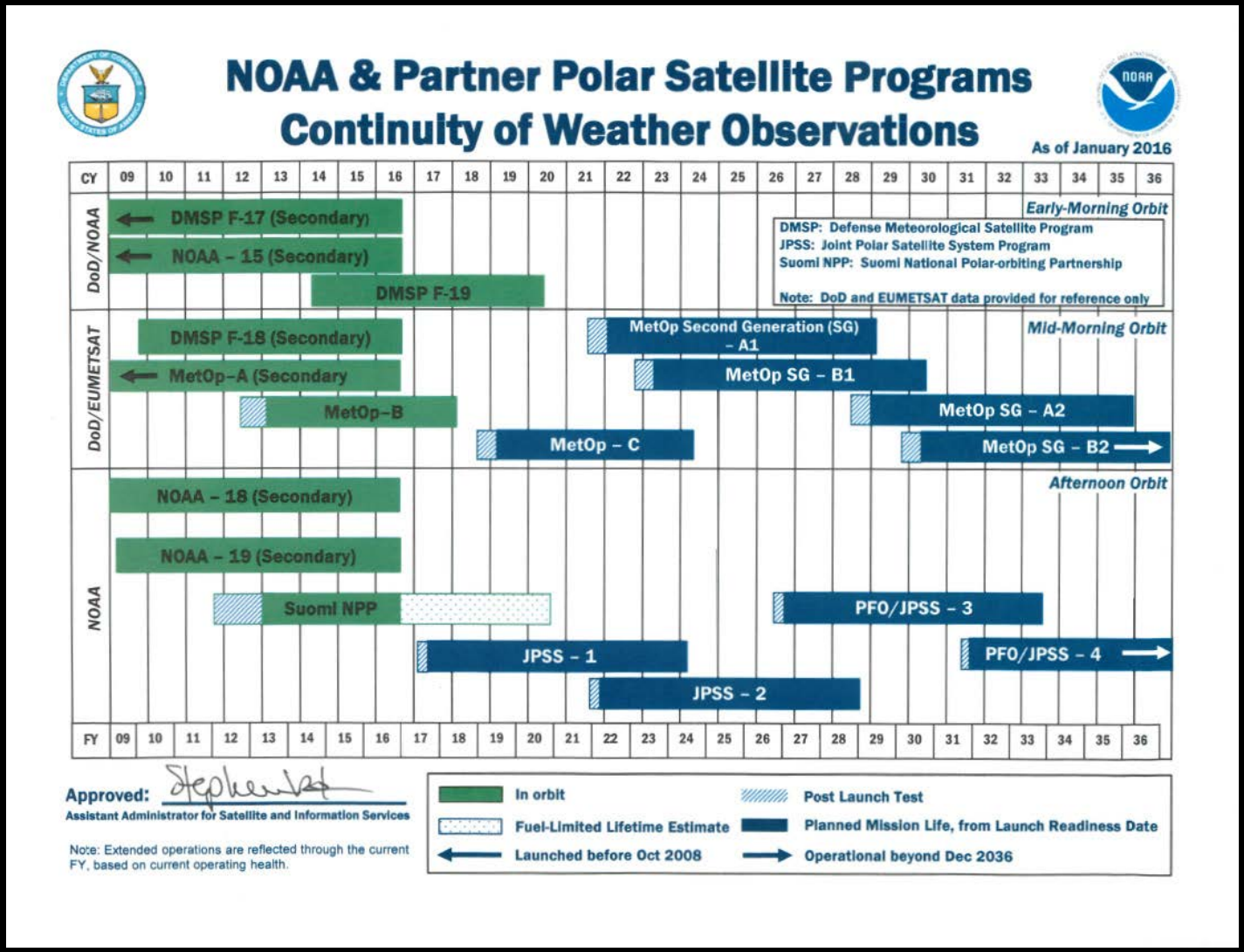
Joint Polar Satellite System
National Environmental Satellite, Data, and Information Service
U.S. National Oceanic and Atmospheric Administration
U.S. Department of Commerce

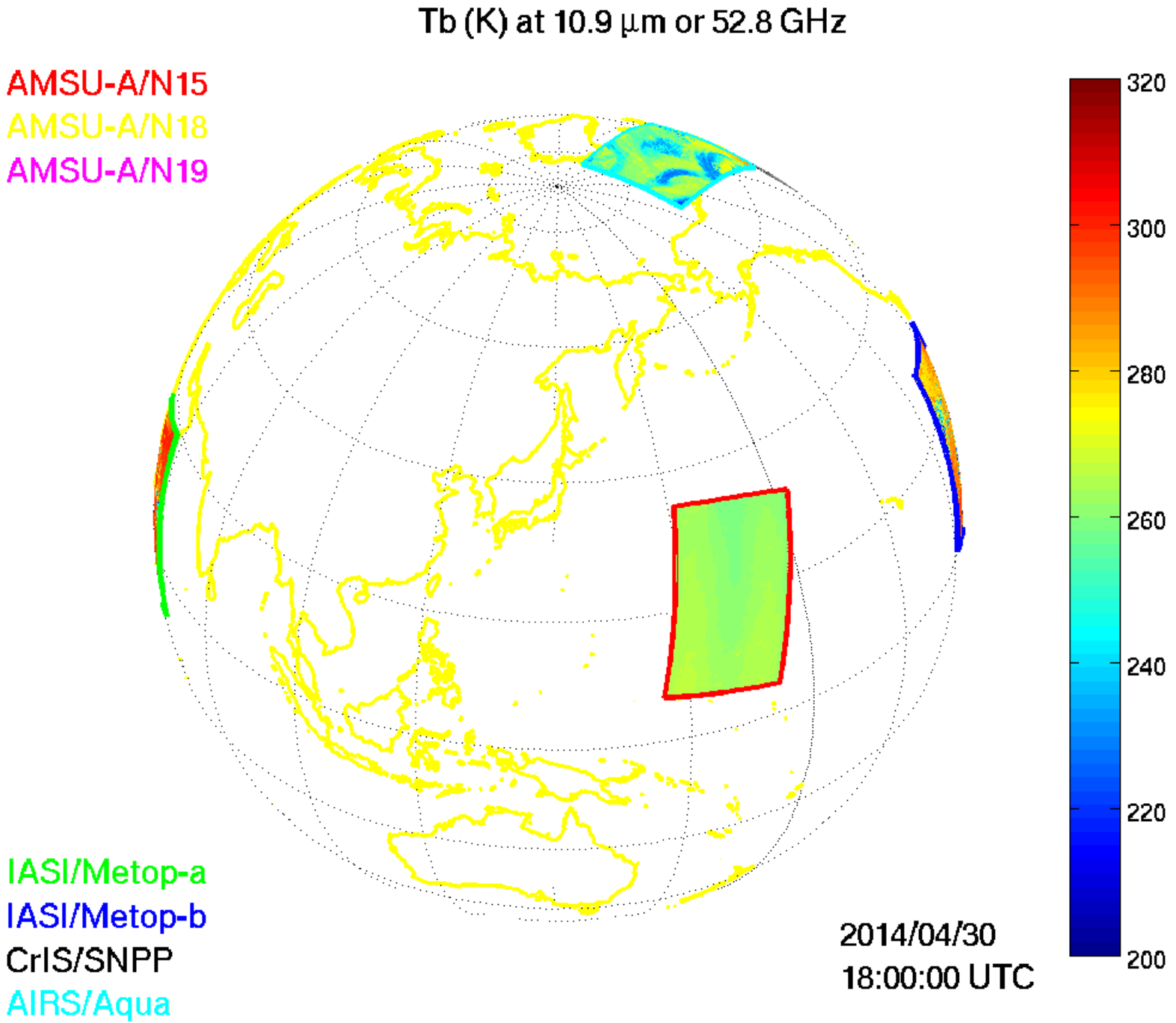


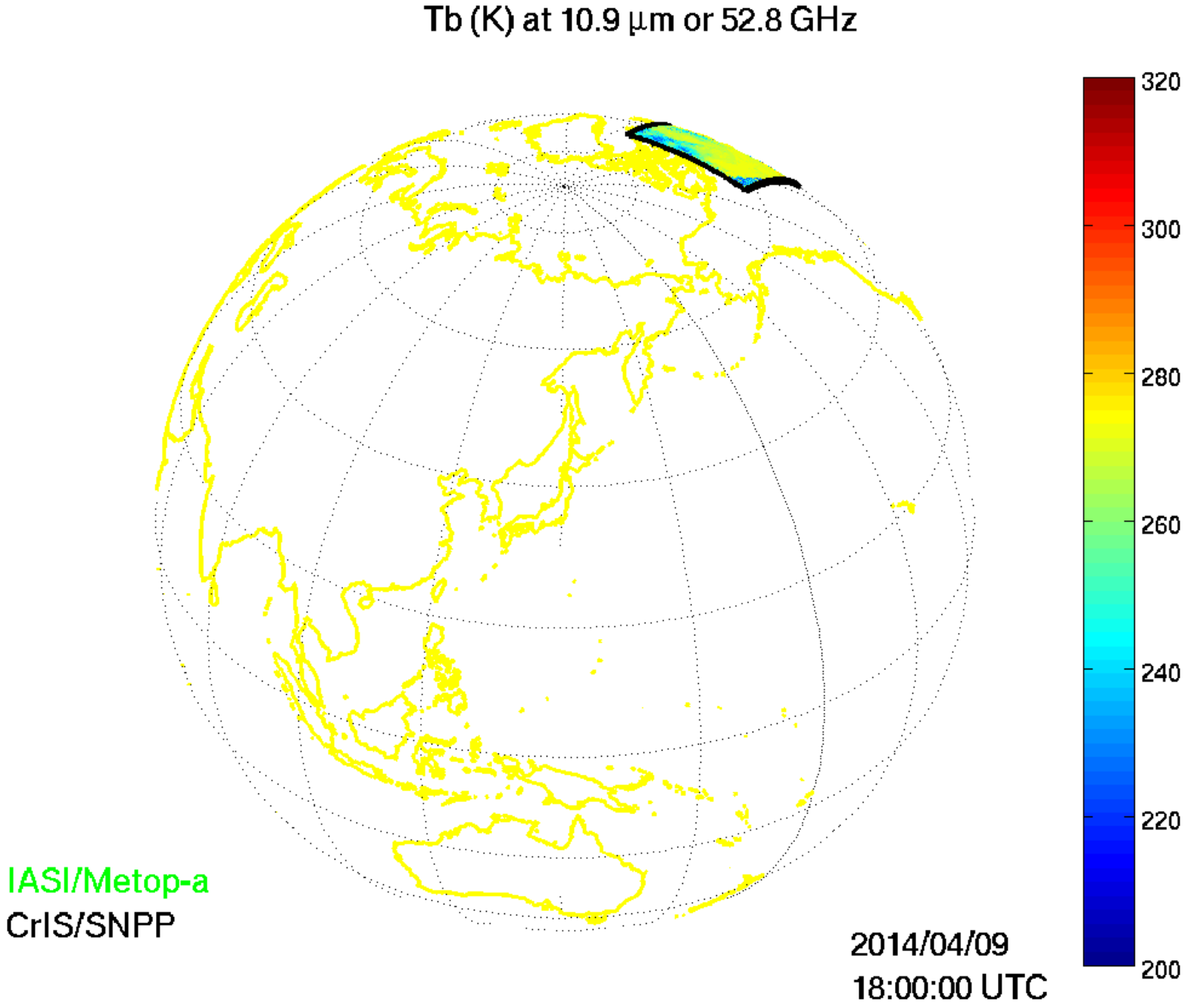
JPSS SCIENCE MEETING
August 2016

www.jpss.noaa.gov

Polar Flyout Chart

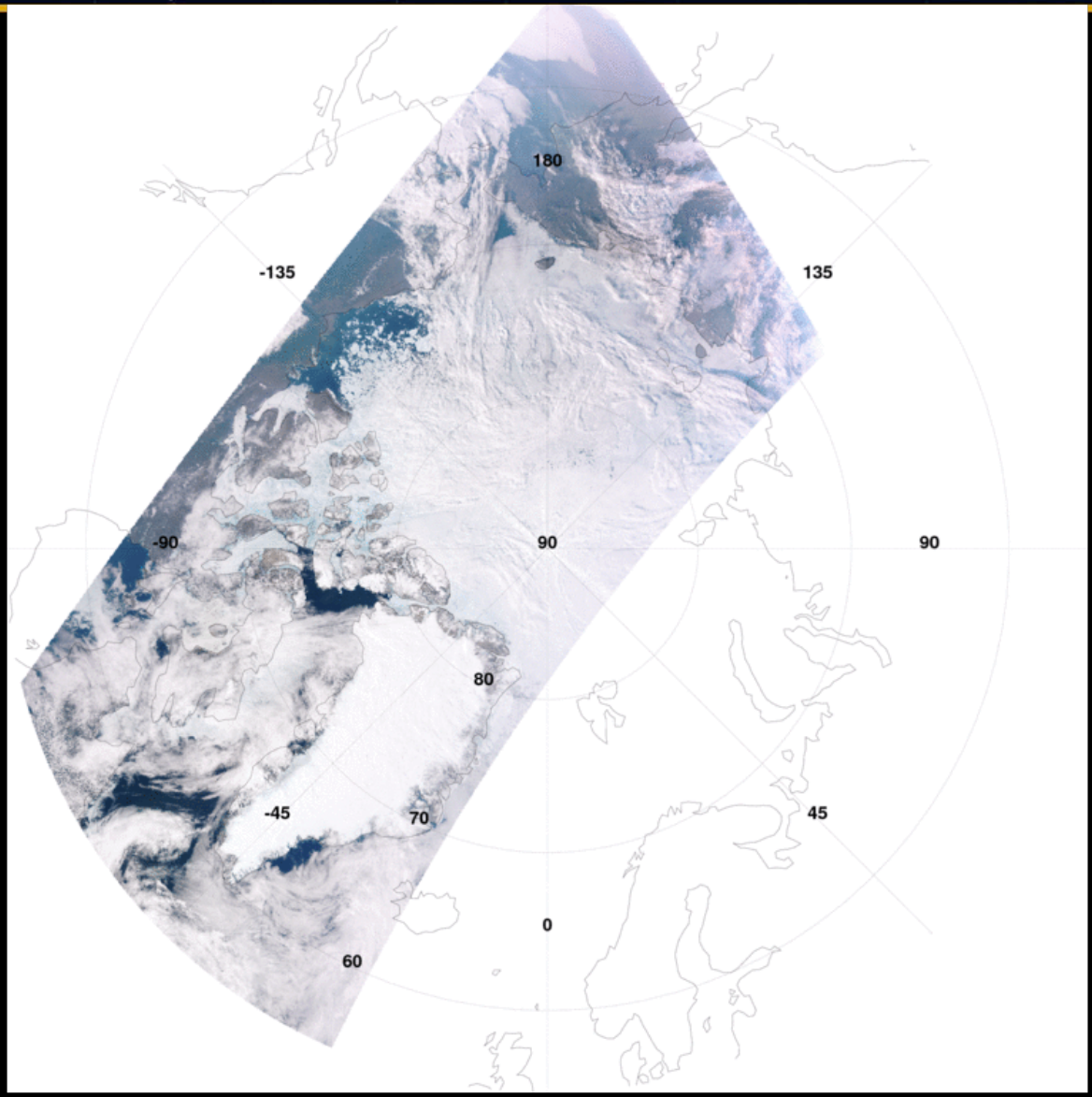



Tb (K) at 10.9 μm or 52.8 GHz
AMSU-A/N15
AMSU-A/N18
AMSU-A/N19
320
300
280
260
240
220
200
IASI/Metop-a
IASI/Metop-b
CrIS/SNPP
AIRS/Aqua
2014/04/30
18:00:00 UTC


Tb (K) at 10.9 μm or 52.8 GHz
320
300
280
260
240
220
200
IASI/Metop-a
CrIS/SNPP
2014/04/09
18:00:00 UTC

Microwave “high temporal”

Perched above the poles



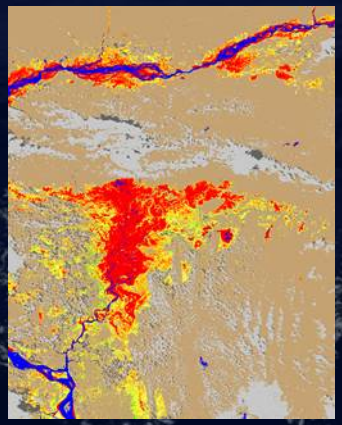
End-to-End Science Approach

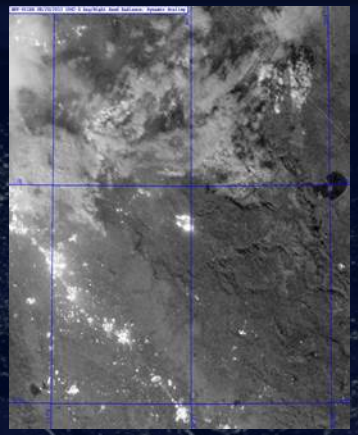
- User requirements and prioritization
  - Determining and prioritizing products user needs - Critical, Supplemental High, Supplement Low(subset of critical becomes Key Performance Parameters (KPP) via LORWG, TPIO, NOSC
  - User input gathered via the LORWG, chaired by Program Scientist.
  - User workshops/conferences to reach broader community
  - Assessing solutions to meet requirements, does the proposed system satisfy the need?.
- Algorithms and Cal/Val
  - Develop algorithms to generate products- meeting requirements (accuracy, precision, latency)
  - Develop tools to visualize /validate the products
  - Generate validation reports, understanding and correcting outliers
  - Provide science and R2O maturity artifacts (Enterprise Life Cycle)
    - ATBDS, Cal/Val Plans, User manuals, Preliminary and Critical Design Reviews, Algorithm and Operational Readiness Reviews
  - Reprocess mission data to maintain consistency of products after algorithms errors are corrected or improvements are made to the algorithm, and deliver reprocessed data to NCEI
  - Delivery of software packages to operations & CSPP (Direct Broadcast package)

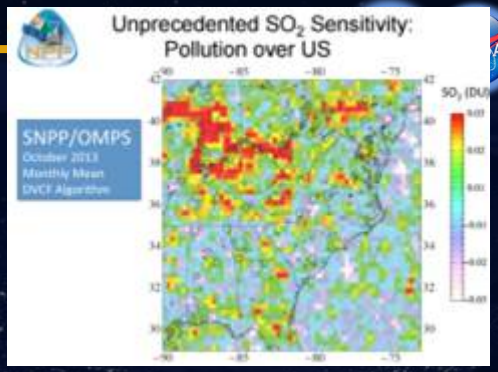
End-to-End Science Approach

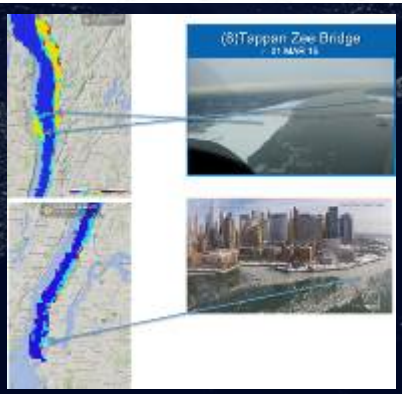
- User Readiness (Proving Ground)
  - User engagement and priorities through JPSS Proving Ground Executive Board and Satellite Development Executive Board and Proving Ground and User Readiness Meeting.
  - Projects to improve NOAA products and services throughout NOAA LOs via infusion of JPSS data into applications (prioritized by PGED/SDEB).
  - Proving Ground Initiative Process for improved user interactions
  - Training for better understanding of how to best use our products in key applications
- New Science (Risk Reduction)
  - To meet user needs (e.g. flood mapping and river ice, improved data fusion of multiple data source)
  - User of Direct Readout to test new algorithms or to further reduce latency.

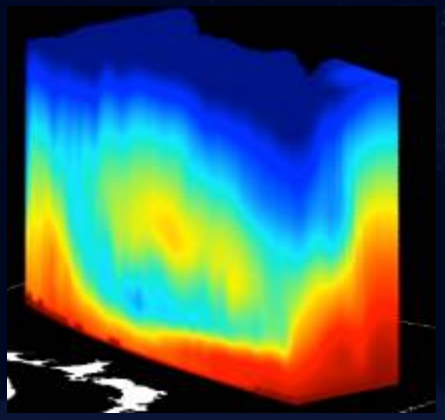
Climb the Application Pyramid





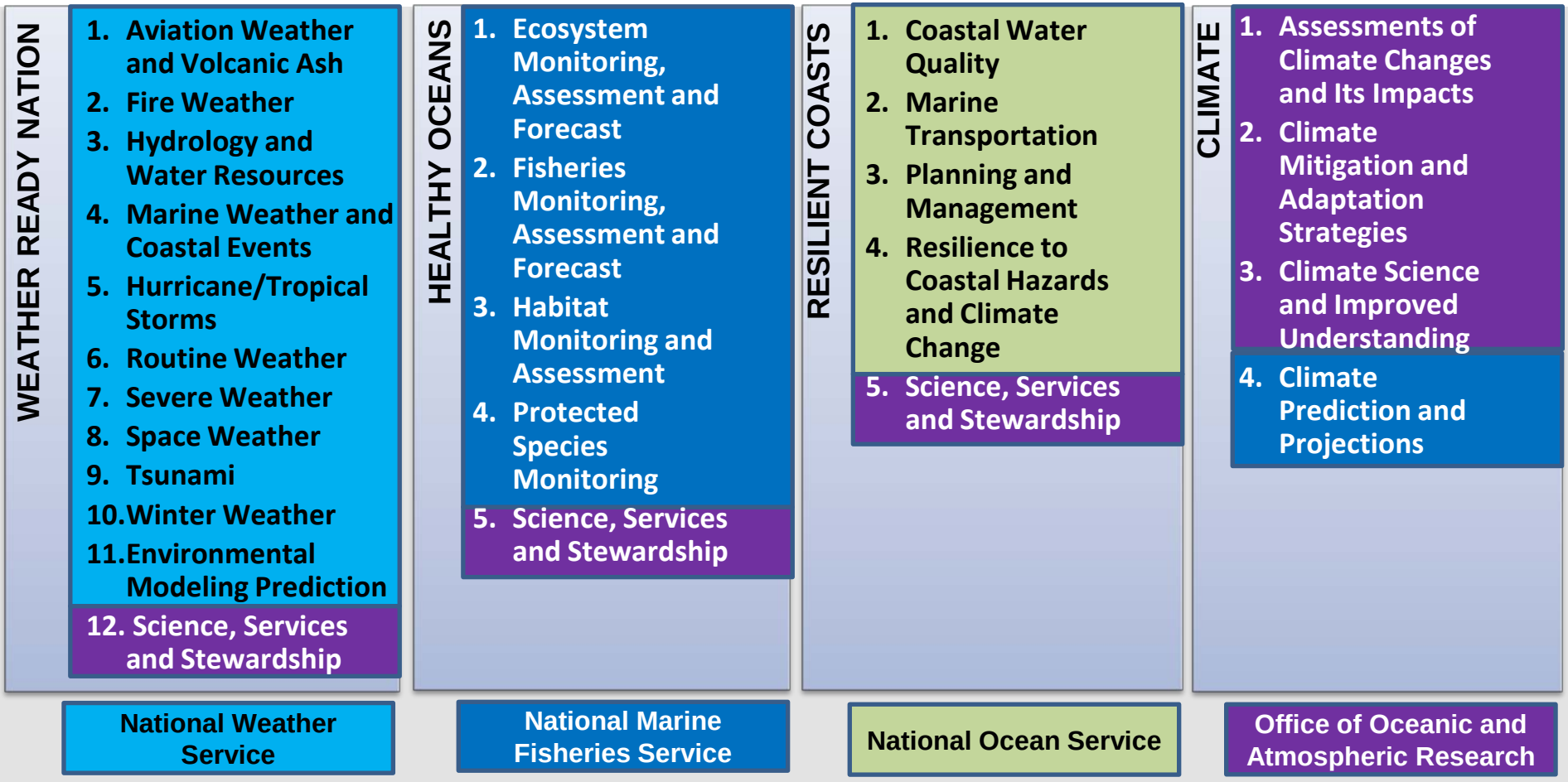






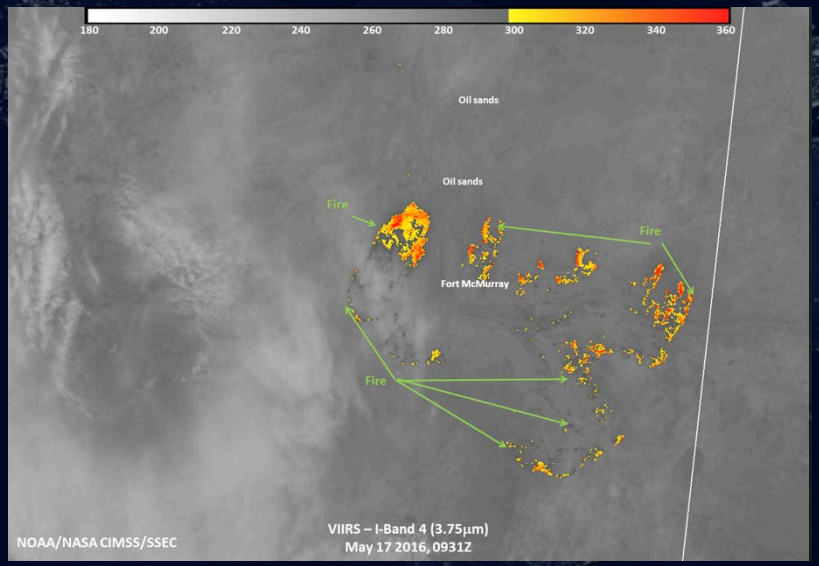
- Decisions
- Warnings
- Impact Assessments
- Specialty Forecasts – e.g., floods
- Weather Forecasts e.g., 3-5 days
- Baseline of Robust and Accurate Observations

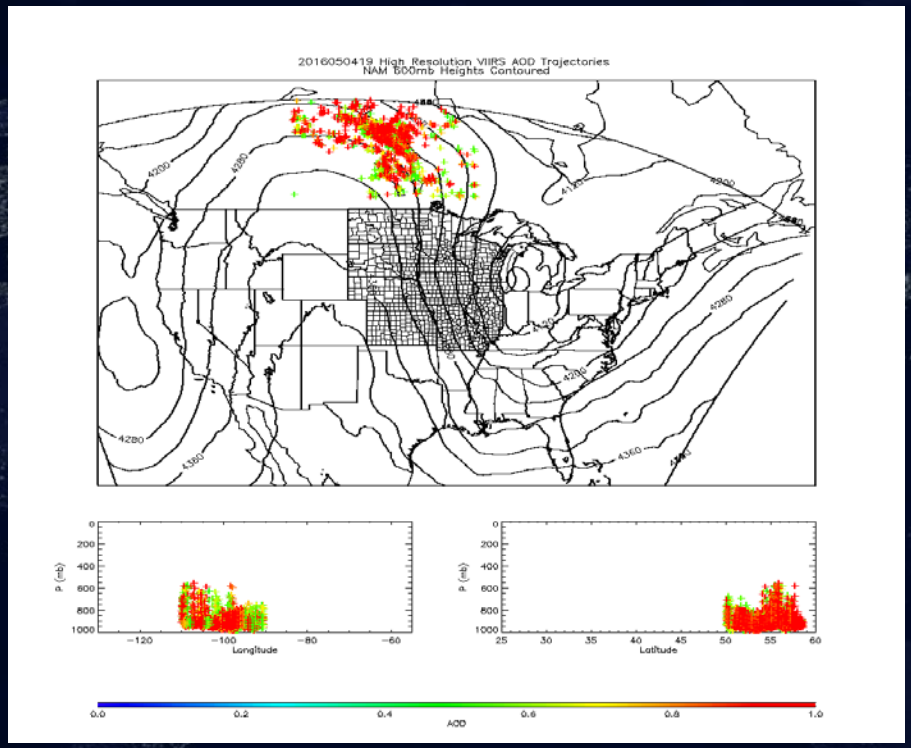
Addressing Needs Across NOAA



NOAA Mission Service Areas by Line Office

Improved smoke air quality forecasting





High resolution (NAM 3km) trajectory forecast
Fort McMurray Wildfire May 04, 2016
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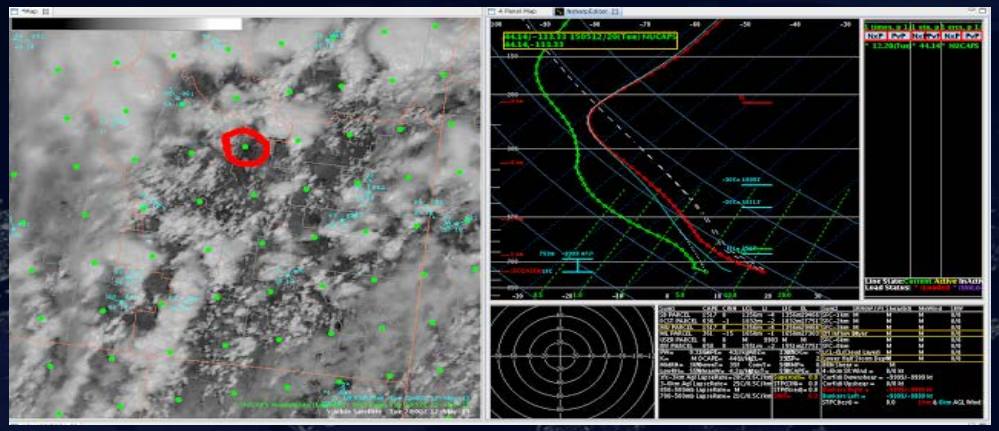
JPSS Applications Advancements

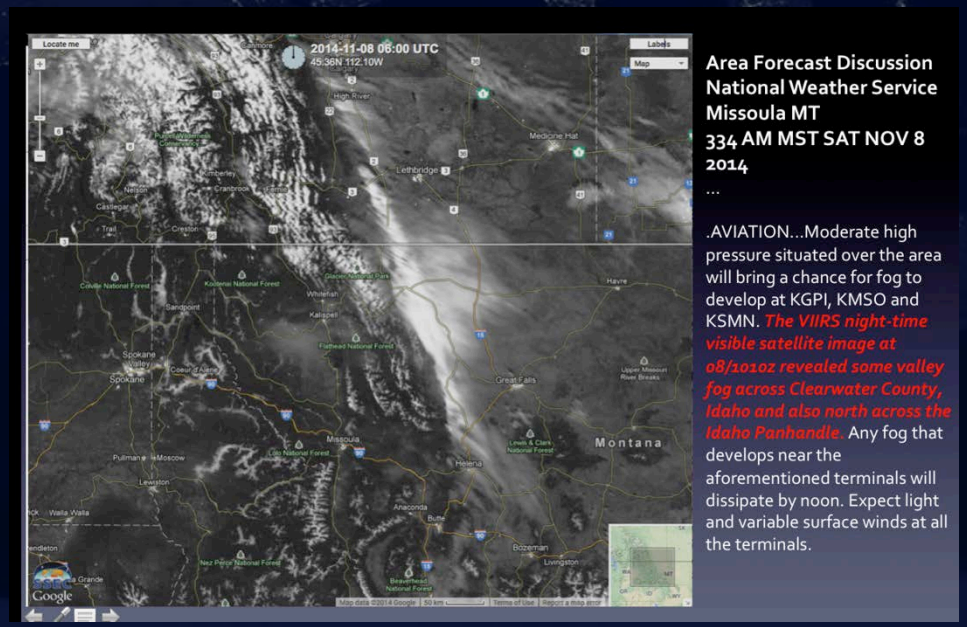
Sounding Products

- On AWIPS and AWIPS Thin Client
- Demonstrations with operational forecasters at 2015 & 2016 Spring Experiment
- Support storm watches and warnings



Day Night Band

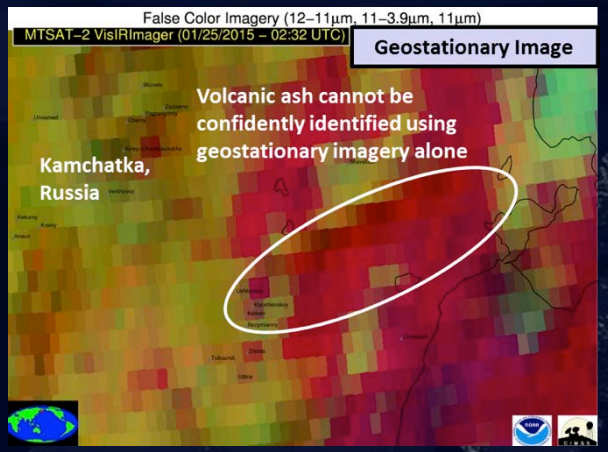
- NCC/DNB now on AWIPS
- Sea Ice
- Storm tracking at night
- Ground Fog
- Active fires and smoke
- Socio / Economic / Impact assessment

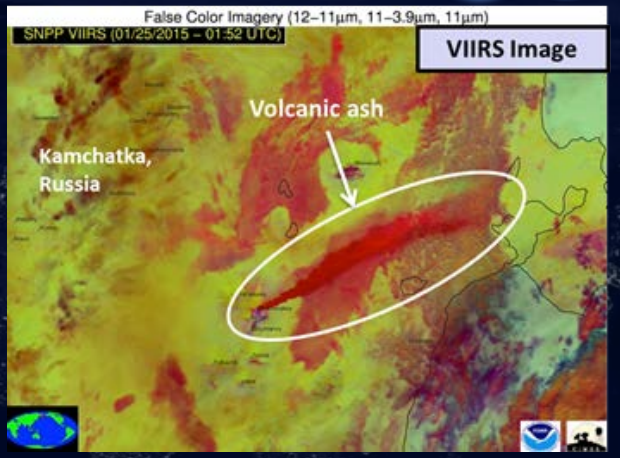


JPSS Applications Advancements

Volcanic Ash

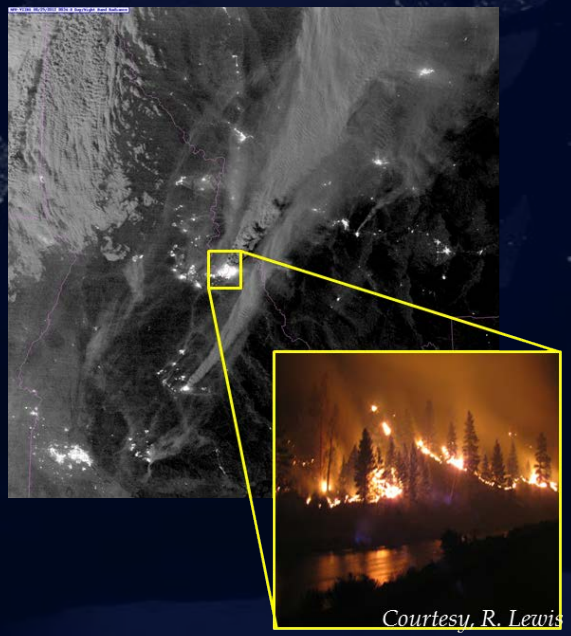
- Wide swath, near constant resolution
- More detections, better plume monitoring / predictions





Active Fires

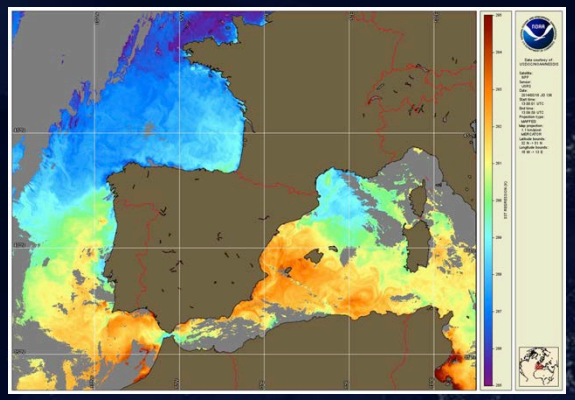
- Fire radiative power
- DNB tracking
- Improved visible resolution/ swath
- Successful field studies

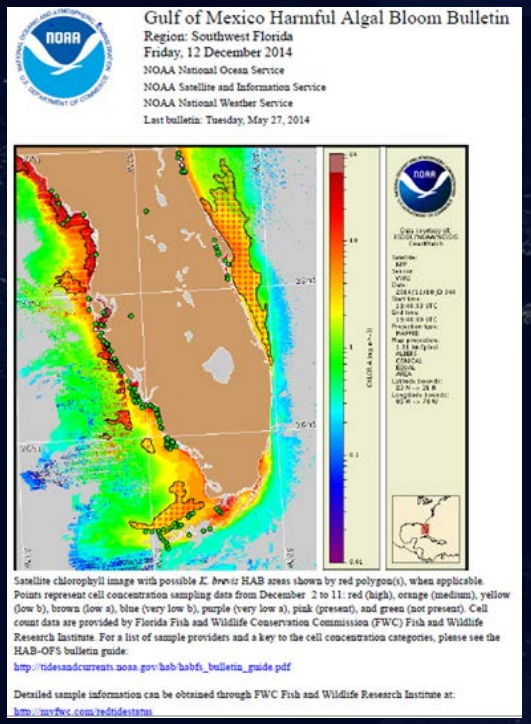


JPSS Applications Advancements

Oceanography

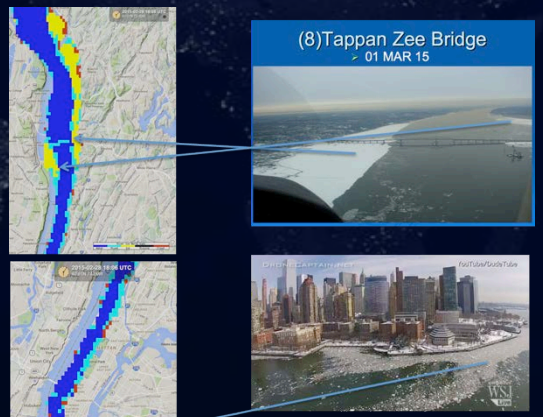
- Improved sea surface temperature
- Highly calibrated global ocean color





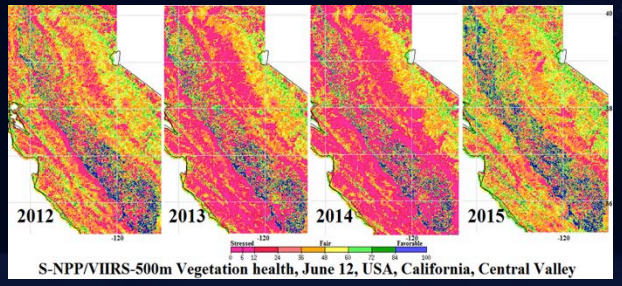
Hydrology

- Ice blockage
- Flood prediction / monitoring



Land

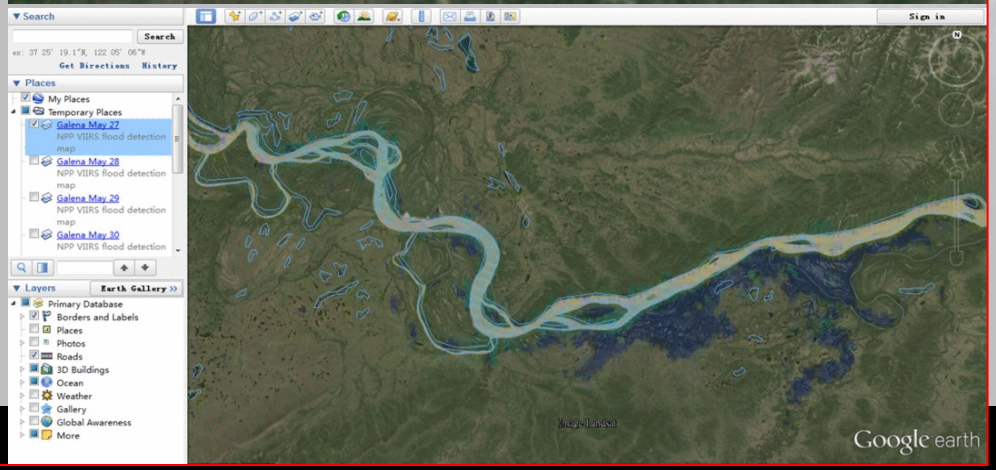
- Green Vegetation Fraction
- Vegetation Stress



Successful demonstration of VIIRS flood mapping and river ice products with NWS River Forecast Centers (RFCs) (Alaska Pacific, North Central and Ohio Riv

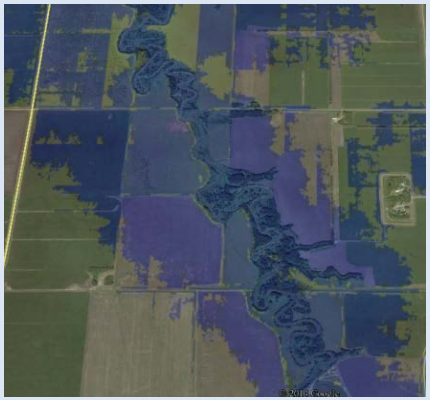
JPSS Proving Ground presented flood map and river ice examples to RFC's and received strong user support for further evaluation.

- JPSS PG established an operational demonstration work plan with the RFCs which included implementation of algorithm in CSPP (direct readout), experimental products in AWIPS and assessment from users (RFCs) including validation with airborne imagery.



- VIIRS can identify river ice jams which can lead to large flood events
- Flooding from ice jams can occur in a very short time
- Flooding can occur from snow melt and heavy rains

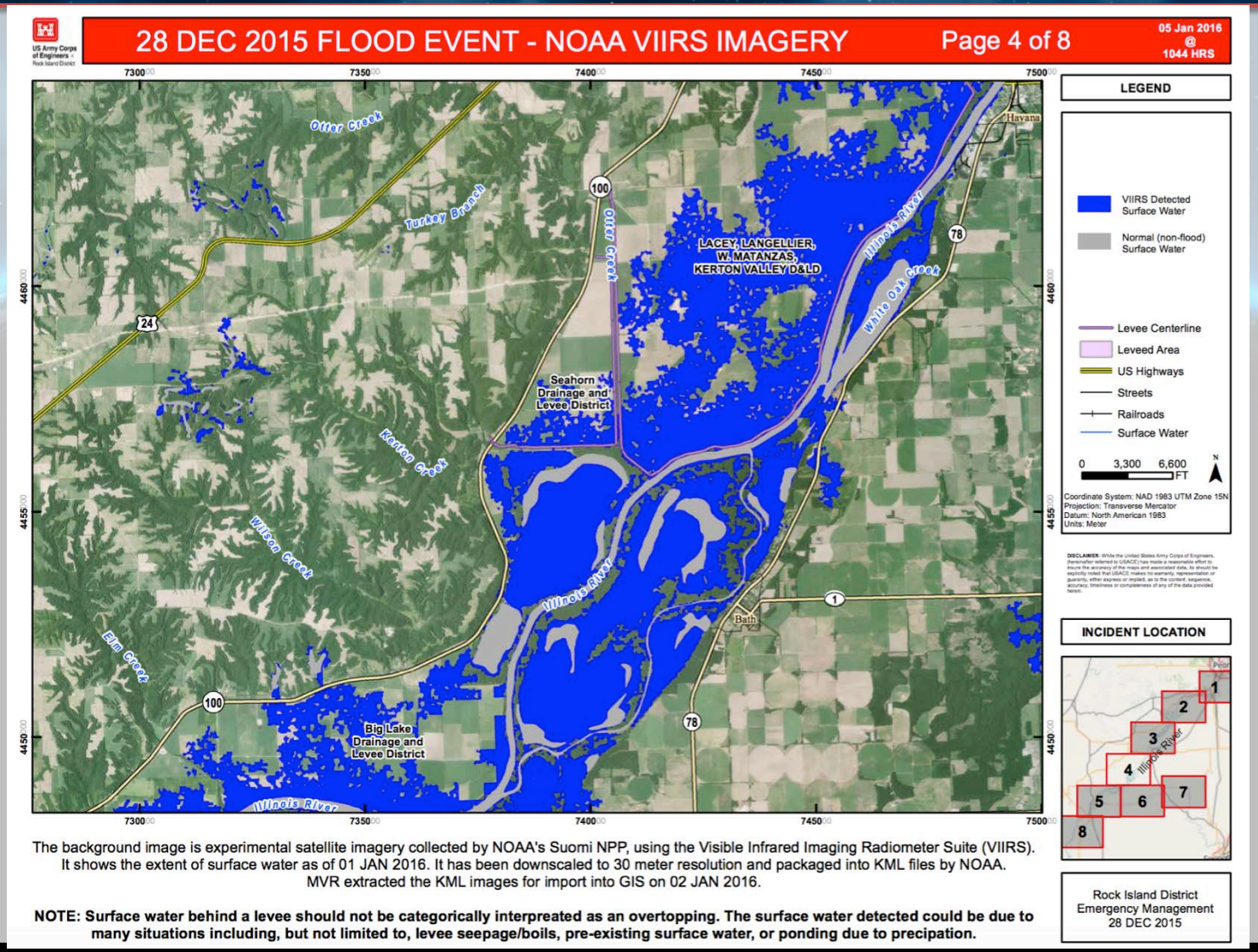
April 15, 2014
Red River Flooding from snow melt



Feedback from the RFCs

- *"River ice vs no ice detection appears excellent"*
- *"Prove useful delineating area of active snowmelt at multiple basin scales"*
- *"All RFCs identified significant value and future potential for river forecasting applications"*
- *"Color coded products with overlays are easily interpreted by forecasters"*
- *"Will formally request product to become operational"*

VIIRS flood product being used by Army Corp of Engineers



The background image is experimental satellite imagery collected by NOAA's Suomi NPP, using the Visible Infrared Imaging Radiometer Suite (VIIRS). It shows the extent of surface water as of 01 JAN 2016. It has been downscaled to 30 meter resolution and packaged into KML files by NOAA. MVR extracted the KML images for import into GIS on 02 JAN 2016.

NOTE: Surface water behind a levee should not be categorically interpreated as an overtopping. The surface water detected could be due to many situations including, but not limited to, levee seepage/boils, pre-existing surface water, or ponding due to precipation.

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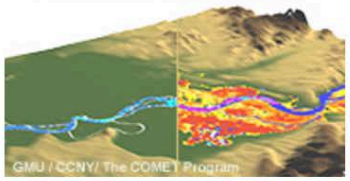
Lesson/Resource Listing » Description

JPSS River Ice and Flood Products



Languages: English
Publish Date: 2016-03-16
Skill Level: 2
Completion Time: .75 – 1.00 h
Includes Audio: no
Required Plugins: none
Topics: Hydrology/Flooding, Satellite Meteorology

Reviews: (1 review)
Read or add reviews

BEGIN LESSON

Add to Queue | Your Queue»

Take the quiz?
Begin Quiz

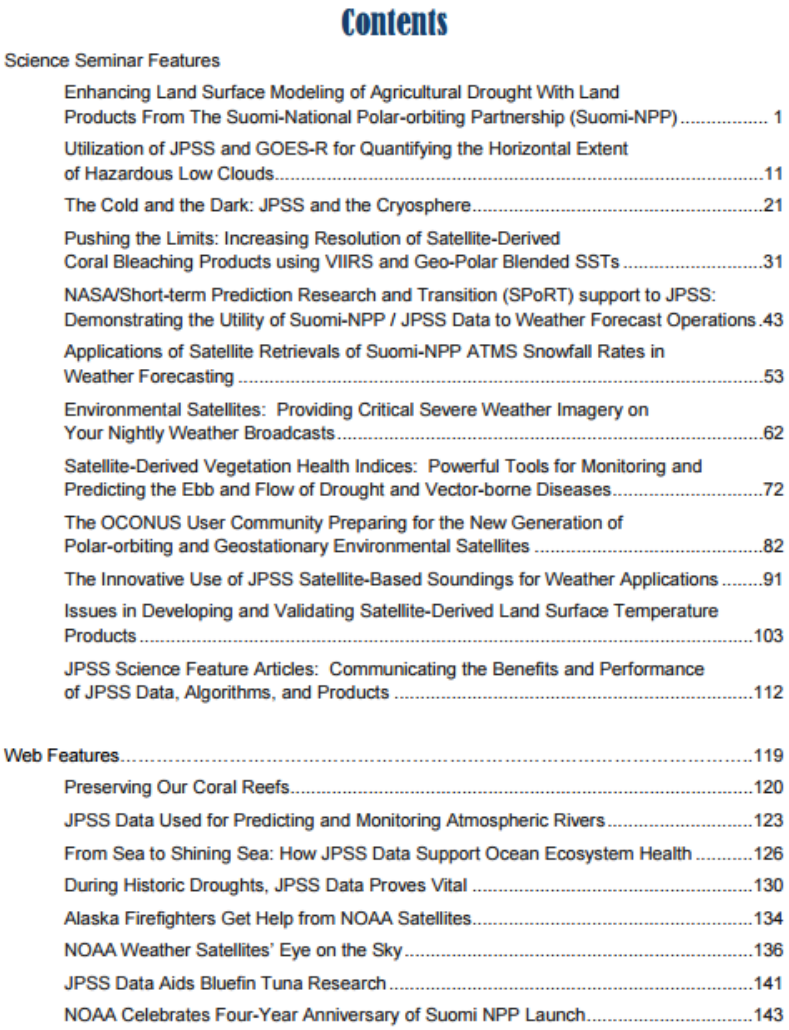
Share this resource: 0

Description | Objectives | Keywords | Media Gallery | Reviews

- Describe the environmental hazards and impacts of river ice and flooding, and the need for river ice and flood water observations
- Describe the capabilities and advantages of the JPSS satellites for monitoring surface conditions
- Describe the role of the River Ice and Flooding Product Initiative in developing the JPSS river ice and flood mapping products
- Describe the new JPSS products for monitoring river ice and flooding, including their strengths and limitations and role in supplementing other types of observations
- Describe how the JPSS products are used to monitor the evolution of river ice and flooding

Want to learn more?

- 2013, 2014 and 2015 Annual Science Digests are available
- Join our monthly JPSS Science Seminars http://www.jpss.noaa.gov/science-seminars.html
- Check out the JPSS Website http://www.jpss.noaa.gov/



Contents

THE EUMETSAT SATELLITE PROGRAMMES

AN OVERVIEW FROM NOW TO THE FUTURE

EUMETSAT

Kenneth Holmlund
EUMETSAT

R. Stuhlmann, P. Schlüssel,

D. Klaes, R. Munro, F. Montagner,
J. Grandell, C. Hanson
And many other contributors
from EUMETSAT and its partners

Current EUMETSAT satellite fleet – Extrapolated to end 2016

METOP -A and -B
(LOW-EARTH, SUN – SYNCHRONOUS ORBIT)

EUMETSAT POLAR SYSTEM/INITIAL JOINT POLAR SYSTEM

Sentinel -3a
(LOW-EARTH, SUN-SYNCHRONOUS ORBIT)

Copernicus Global Marine and Land Environment Mission
Operated by EUMETSAT

JASON-2, -3
(LOW-EARTH, 63° INCL. NON SYNCHRONOUS ORBIT)

OCEAN SURFACE TOPOGRAPHY MISSION

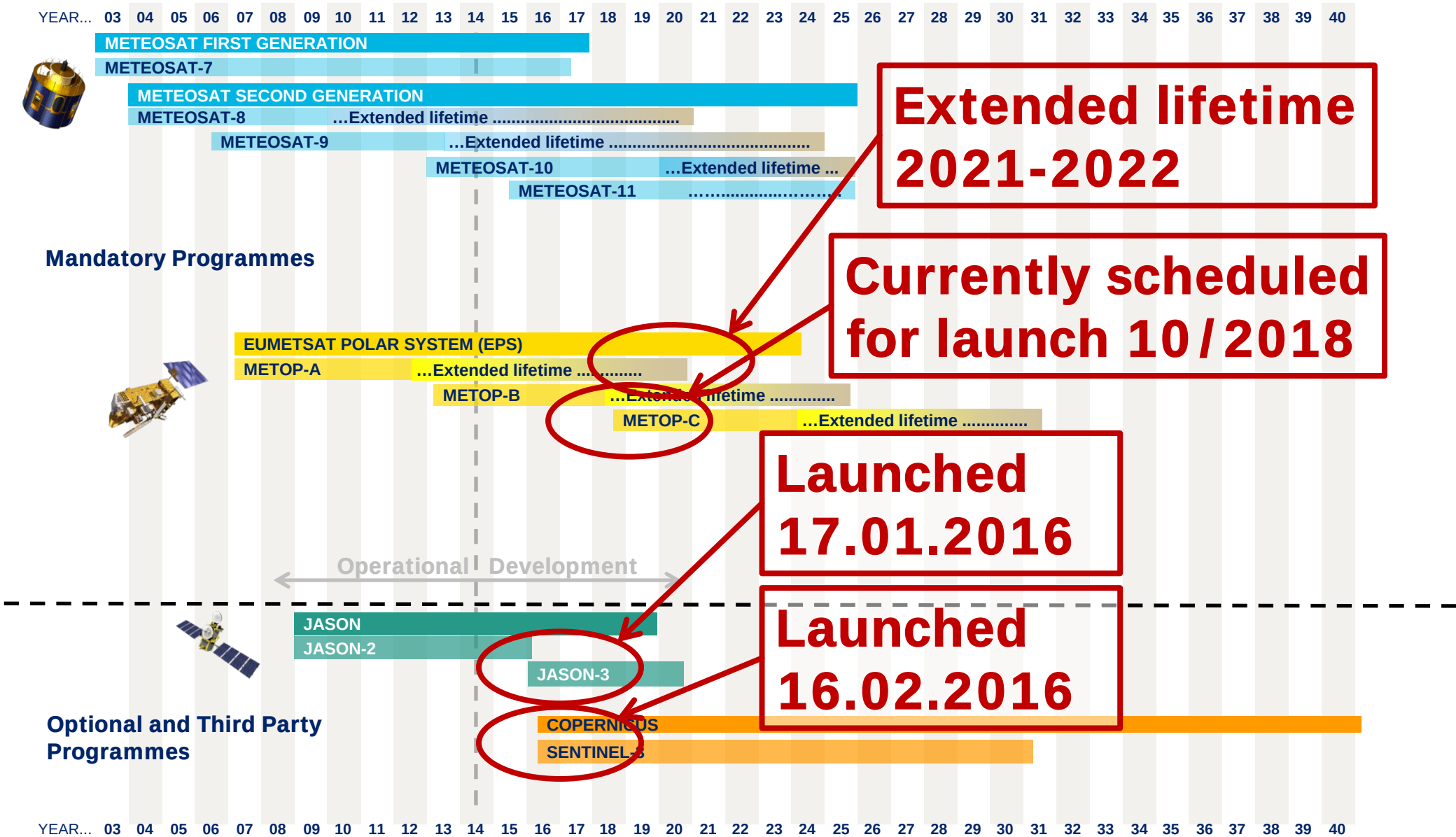
METEOSAT SECOND GENERATION -9, -10, -11
(GEOSTATIONARY ORBIT)

TWO-SATELLITE SYSTEM:
- METEOSAT-11: IN-ORBIT BACKUP
- METEOSAT-10: FULL DISK IMAGERY MISSION AT 0° (15 MN)
- METEOSAT-9: RAPID SCAN SERVICE OVER EUROPE AT 9.5°E (5 MN)

METEOSAT -8 (2nd GENERATION)
(GEOSTATIONARY ORBIT)

INDIAN OCEAN DATA COVERAGE MISSION
AT 40° E (TBD June 2016)

EUMETSAT programmes overview



Extended lifetime 2021-2022

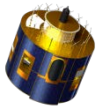
Currently scheduled for launch 10/2018

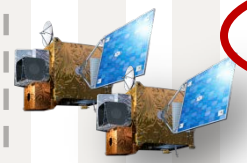
Launched 17.01.2016

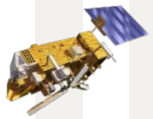
Launched 16.02.2016

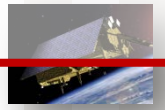
EUMETSAT

EUMETSAT programmes overview









YEAR... 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

METEOSAT FIRST GENERATION

METEOSAT-7

METEOSAT SECOND GENERATION

METEOSAT-8 …Extended lifetime .....

METEOSAT-9 …Extended lifetime .....

METEOSAT-10 …Extended lifetime ...

MSG-4/METEOSAT-11 .....

First launch 2020

METEOSAT THIRD GENERATION

MTG-I-1 : IMAGERY

MTG-S-1: SOUNDING

MTG-I-2: IMAGERY

MTG-I-3: IMAGERY

MTG-S-2: SOUNDING

MTG-I-4: IMAGERY

First Launch 2021

Mandatory Programmes

EUMETSAT POLAR SYSTEM (EPS)

METOP-A …Extended lifetime .....

METOP-B …Extended lifetime .....

METOP-C …Extended lifetime .....

METOP SECOND GENERATION

METOP-SG-A1

METOP-SG-B1

METOP-SG-A2

METOP-SG-B2

METOP-SG-A3

METOP-SG-B3

Operational Development

Current Launch year 2020

JASON

JASON-2

JASON-3

JASON CONTINUITY OF SERVICE (JASON-CS)

COPERNICUS

SENTINEL-3

SENTINEL-4 ON MTG-S

SENTINEL-5 ON EPS-SG

Optional and Third Party Programmes

YEAR... 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

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MTG Programme – Space Segment

Twin satellite concept – based on 3-axis platforms:

4 geostationary imaging satellites **(MTG-I)**

2 geostationary sounding satellites **(MTG-S)**

Established through a cooperation between:

esa

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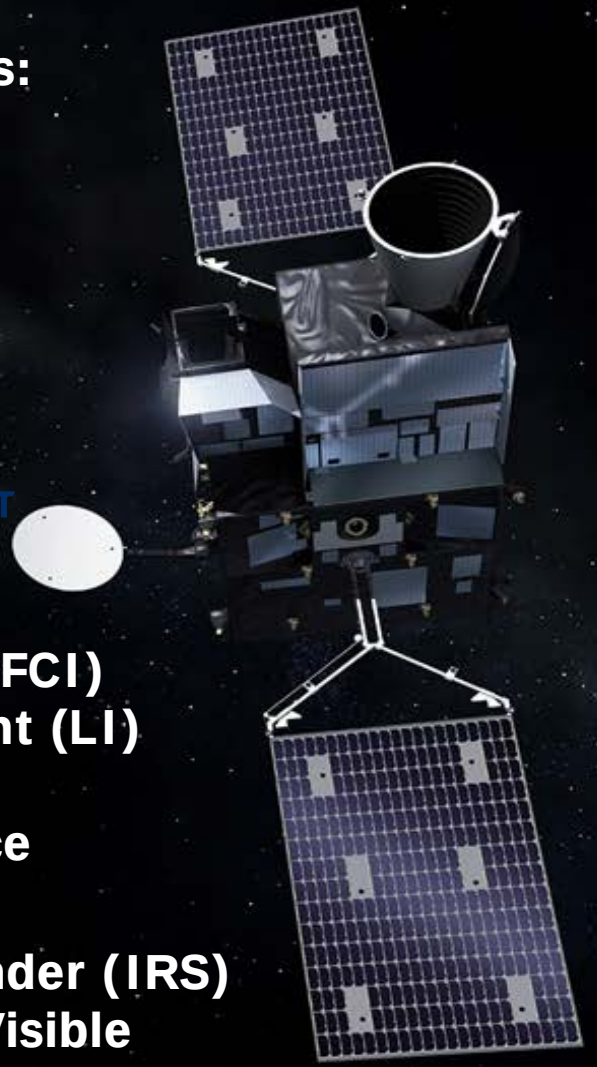


MTG-I: - Flexible Combined Imager (FCI)
- Lightning Imager Instrument (LI)

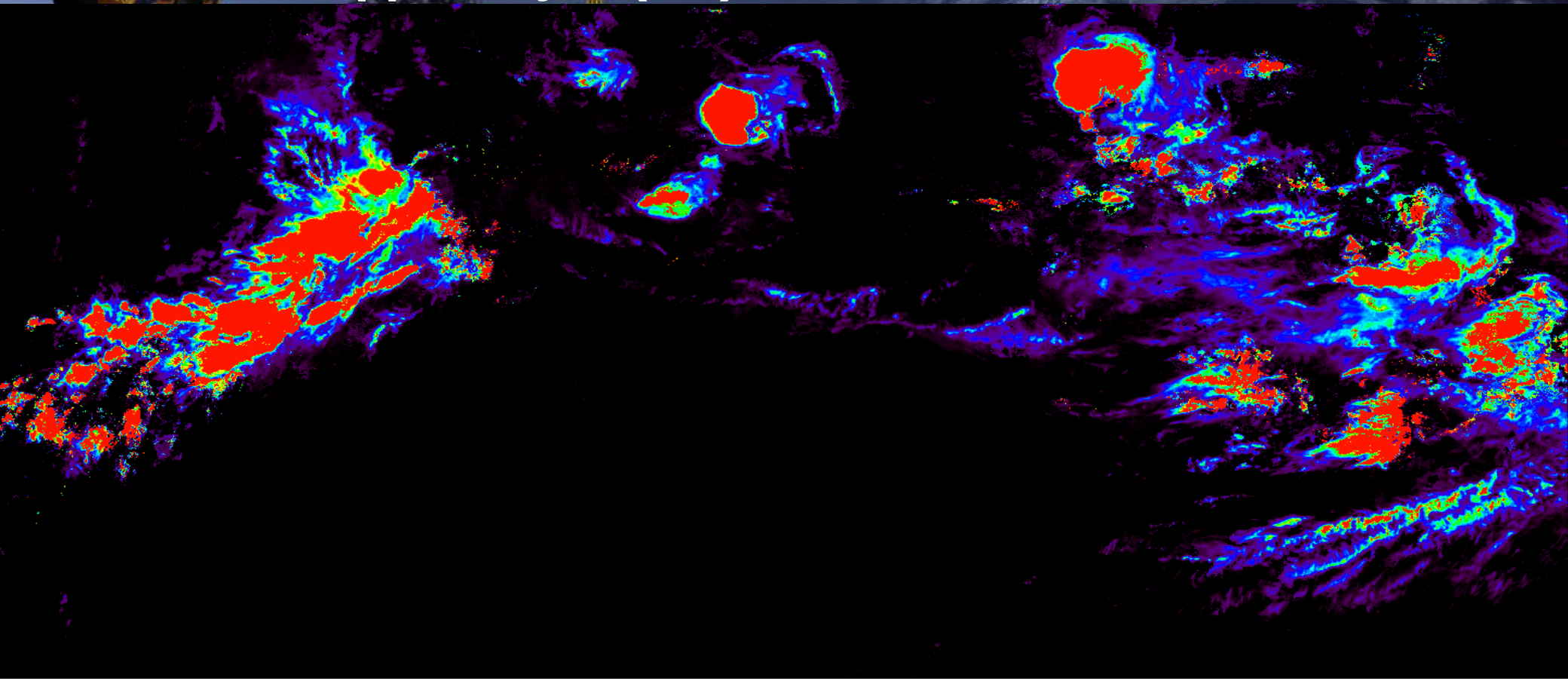
20 years of operational service

MTG-S: - Infrared Sounder (IRS)
- Ultra-violet, Visible and Near-infrared Sounder (UVN)

15.5 years of operational service

2011 July 25 11:30-12:30

Upper Layer (ice) COT scaled 0-11



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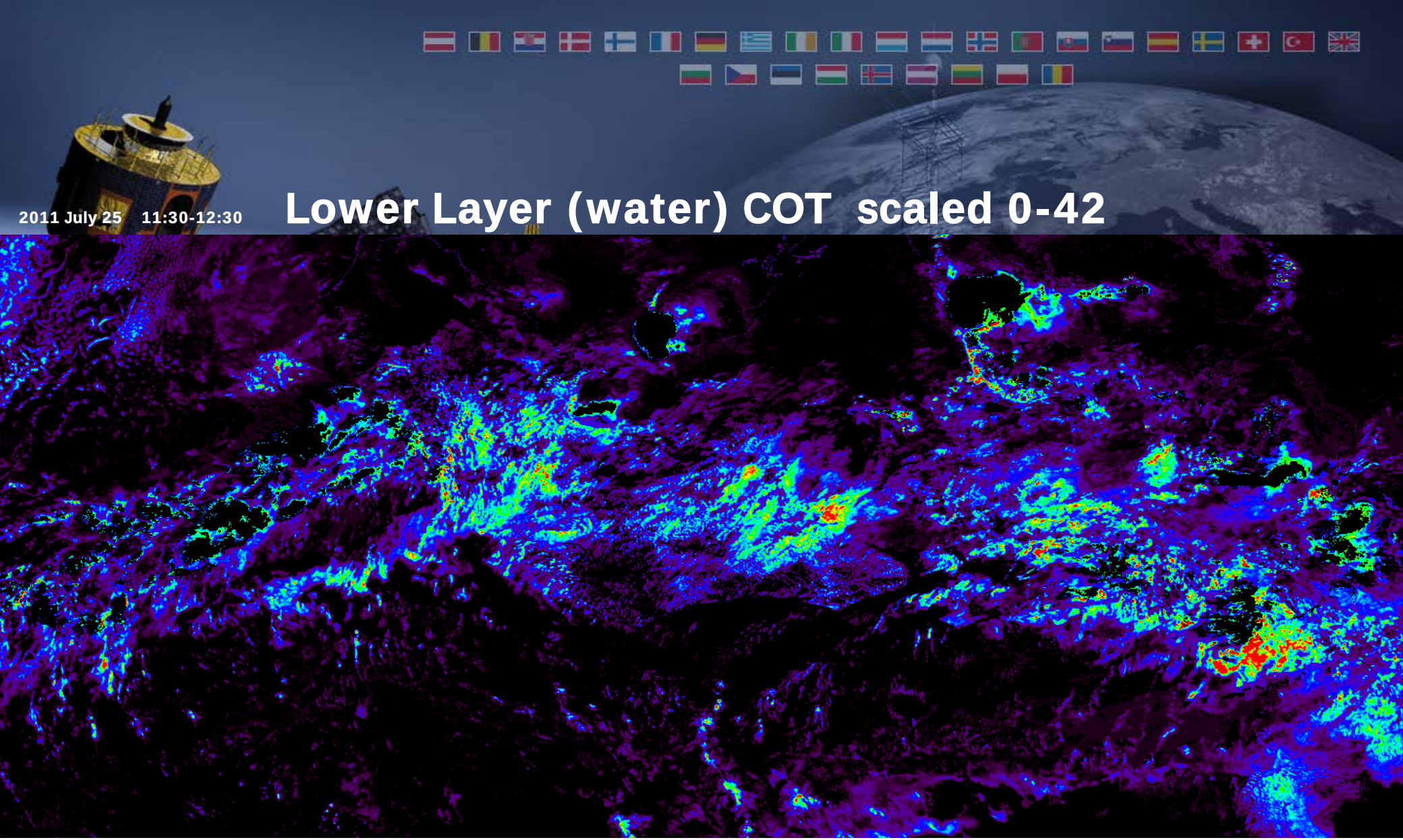

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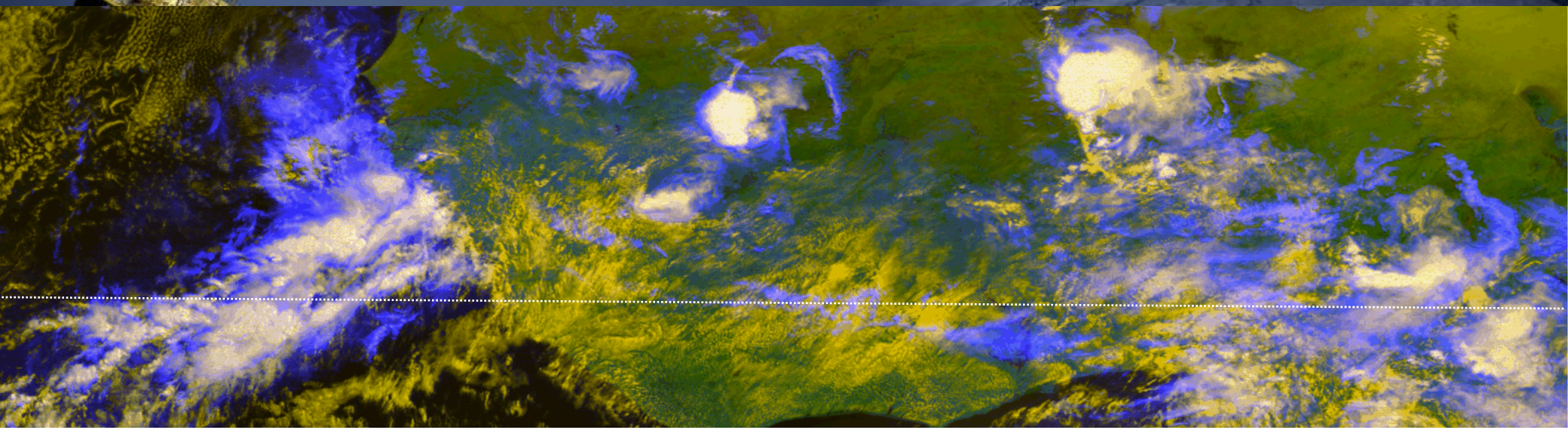
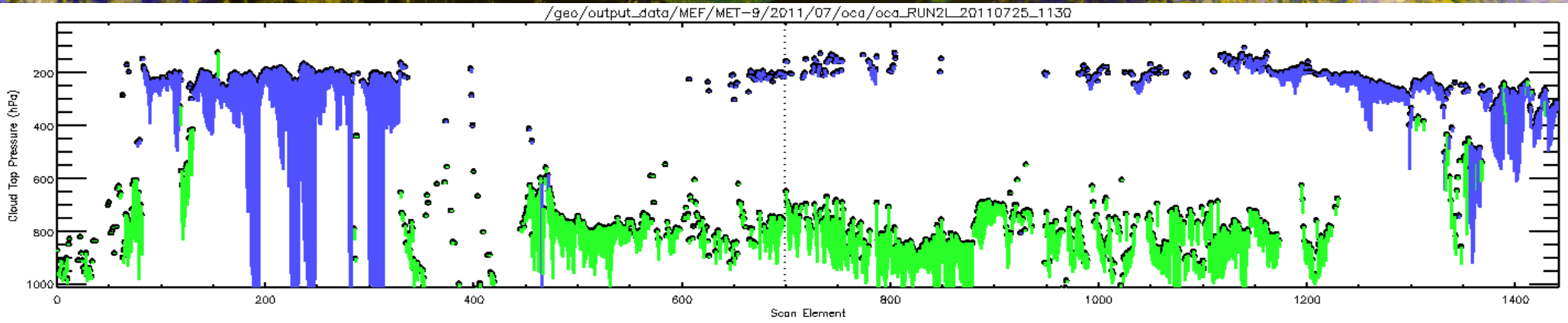
2-Layer Winds?

2011 July 25 11:30-12:30 **RGB 0.6, 0.8, 8-7-11**





Ice blue water green

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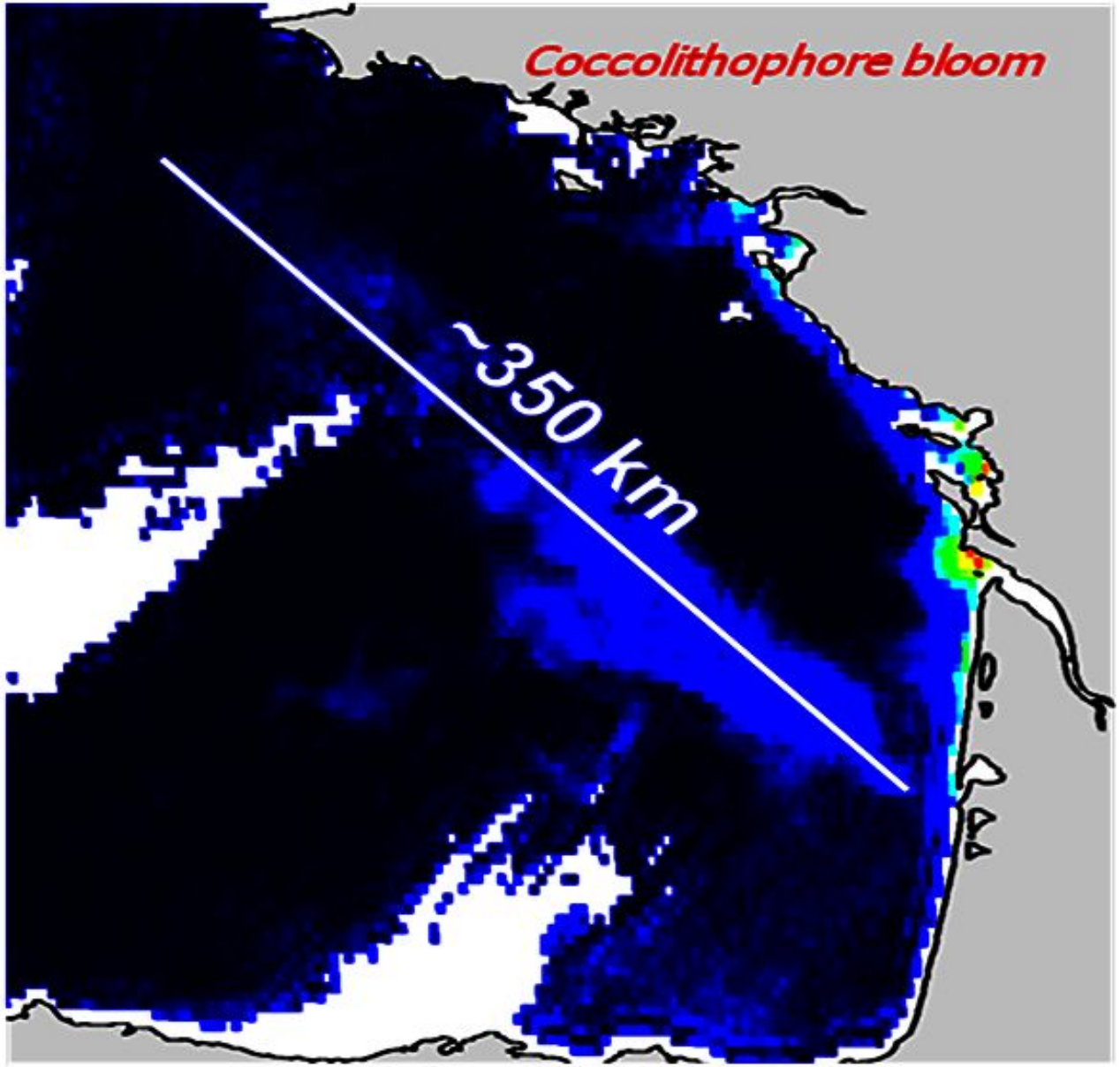
Scientific development for future / enhanced products (3)
Coccolithophore blooms from the geostationary orbit ?



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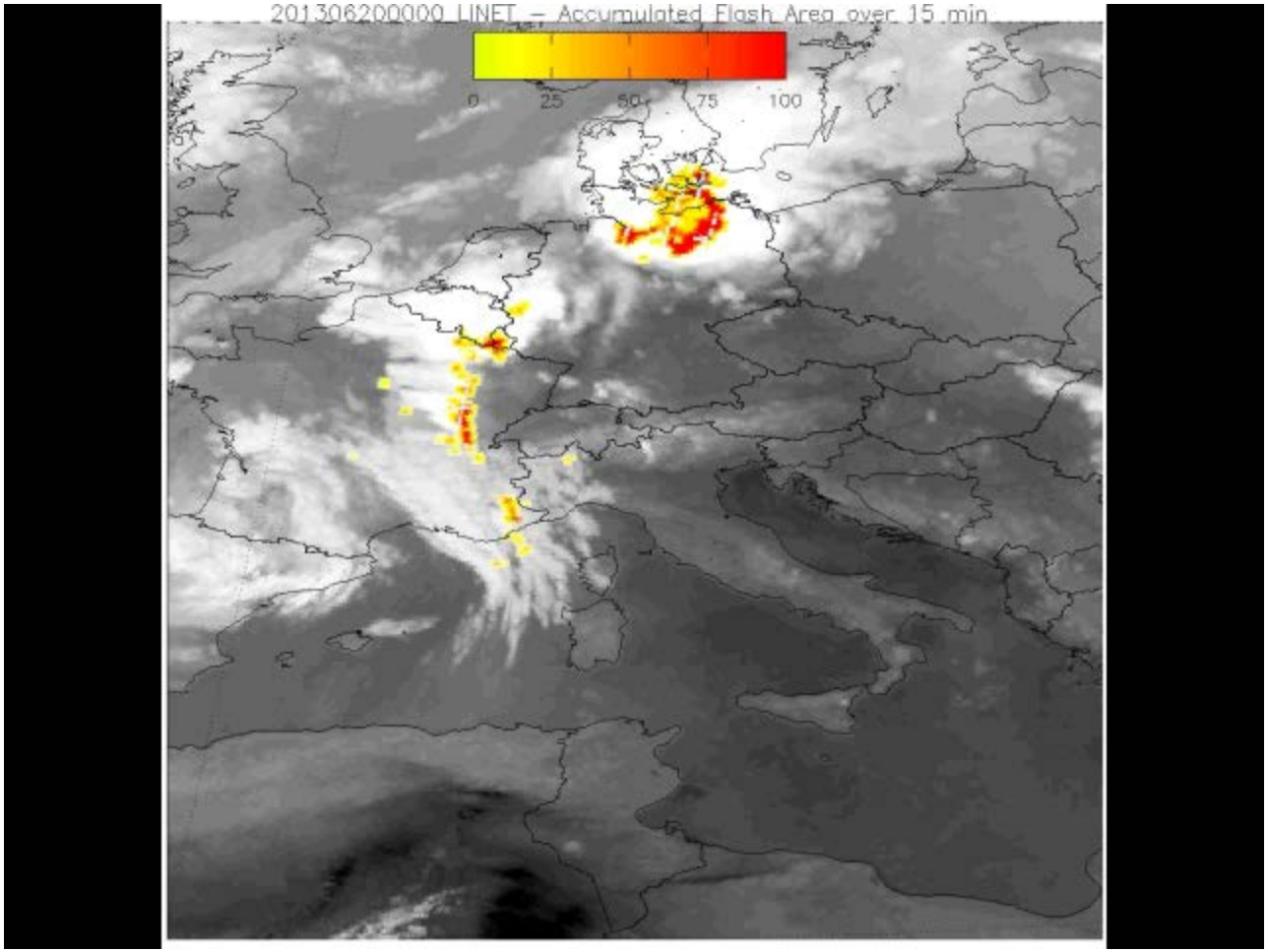
Observing lightning
Reference processor product example

“Accumulated flash area” product, integrated over 15 minutes and updated every 30 seconds
Date: 20 June 2013.



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IRS NRT Demonstration service for Europe

- IRS Nowcasting Workshops
- Assimilation Workshop
  - Very High Resolution Limited Area Moel

- IRS NRT Demonstration service for Europe
  - Aims to involve potential operational users of MTG-IRS Level 2 products in the development of the level 2 processor.
  - The results of this evaluation will be used to identify limitations of the envisaged products and where possible to start mitigation actions in light of the experience with the proxy data.
  - Based on level 2 products from IASI and CrIS
  - Derived vertical profiles (T/H) and T_{surf} with their uncertainty

- For more on IRS see Tjemkes Wednesday 09:40.

The EUMETSAT polar system is part of the joint polar system shared with the US

- A two pillar backbone system:
- NOAA with Suomi-NPP and JPSS provides the afternoon orbit data
- EUMETSAT provides mid-morning data
- Coordination of products and services

- A third pillar? China has committed to the early morning orbit

EUMETSAT

EPS Second Generation

Continuing the European contribution to the Joint Polar System (JPS)

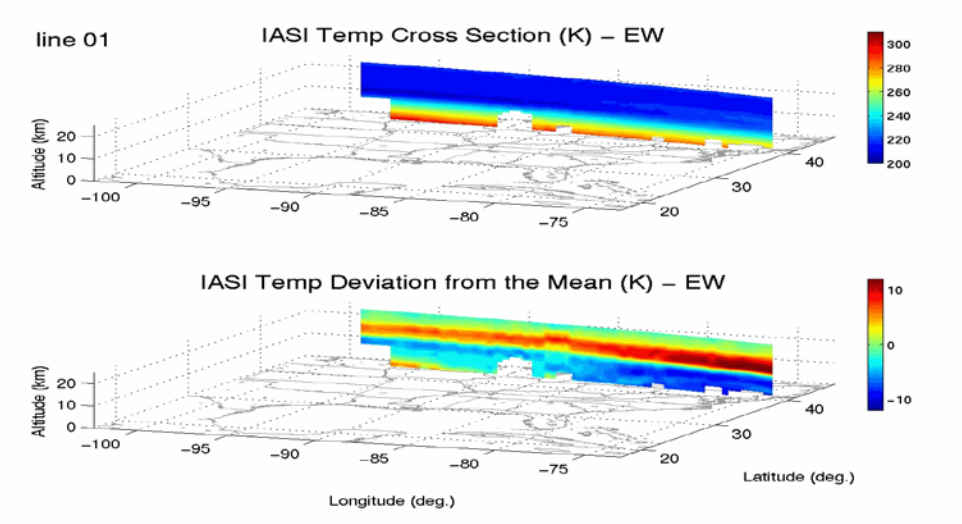
- Emhanced service from mid morning polar orbit in 2021 – 2040
- Twin satellite in-orbit configuration:
  - Metop-SG A: optical imagery and sounding mission
    - Flies the Copernicus Sentinel-5 instrument
  - Metop-SG B: microwave imaging mission
- Two series of 3 successive satellites for 21 years of operations
- Orbit @ 09:30 LTDN (Same as Metop)
- Phasing of Sat-a and Sat-b 180°

	Satellite a	**Satellite b**
Payload	METImage, IASI-NG, MWS, 3MI, S-5, RO	SCA, MWI, ICI, ARGOS-4, RO
Launch mass	3661 kg	3339 kg
Power	2.3 kW	2.0 kW
P/L data rate	54 Mb/s	6.3 Mb/s

Observation Missions

Mission	Instrument	Applications Benefitting
Hyper-spectral Infrared Sounding	IASI-NG	NWP, NWC, Air Quality, CM
Visible/Infra-red Imaging	METimage	NWC, NWP, CM, Hydrology, Oceanography
Microwave Sounding	MWS	NWP, NWC, CM
Radio Occultation Sounding	RO	NWP, CM
Nadir viewing UV/VIS/NIR/SWIR Sounding	Sentinel 5	Ozone-UV, Air Quality, CM, Composition-Climate interactions
Multi-viewing, -channel, -polarisation Imaging	3MI	Air Quality, CM, NWC
Scatterometry	SCA	NWP, NWC, Oceanography, Hydrology
Microwave Imaging	MWI	NWP, NWC, Hydrology, CM, Oceanography
Ice Cloud Imaging	ICI	NWP, NWC, Hydrology, CM

Hyper-spectral infrared sounding: IASI – NG



- **Objectives**
- Temperature/humidity profile at high vertical resolution
- Clouds, trace gases (O_3, CO, CH_4, CO_2,...)
- Sea/land/ice surface temperature
- Aerosols, Volcanic Ash

- **Implementation**
  - Development of Fourier Transform
  - Spectrometer IASI-NG by CNES

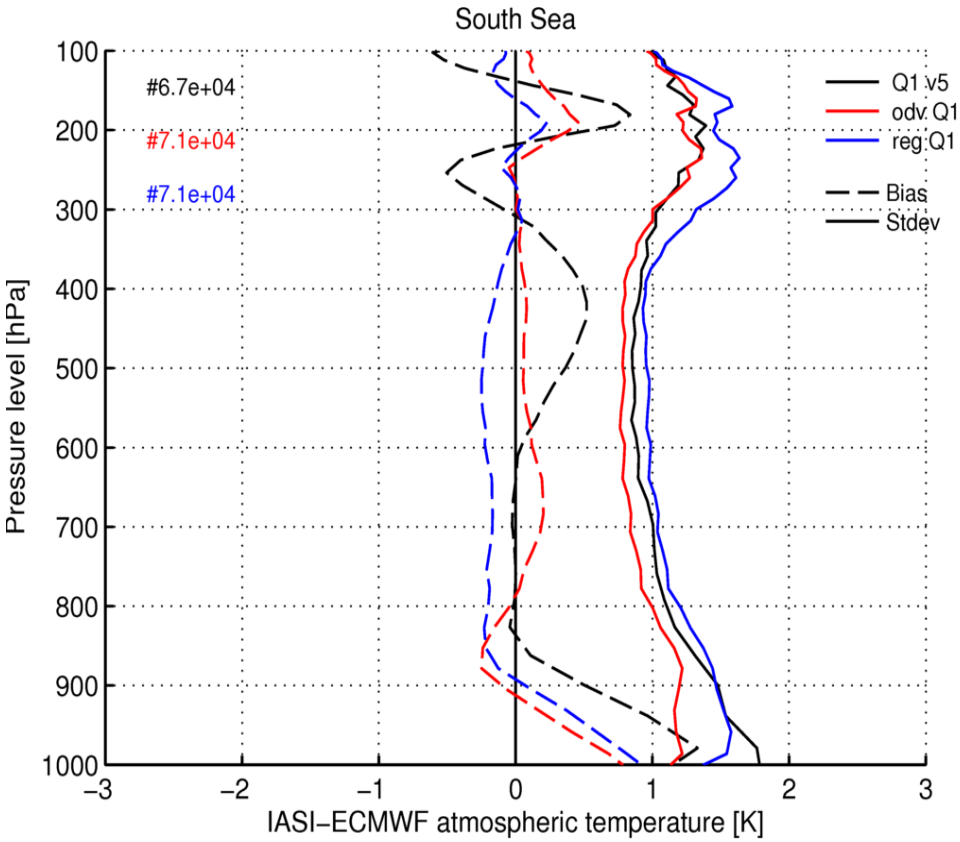
- **Key performances**
- spectral range: 645 – 2760 cm-1
- spectral resolution: 0.25 cm-1
- radiometric calibration: 0.25 K
- stability: 0.1 K
- Radiometric noise: 0.045 – 1.1 K
- pixel size: 12 km
- spatial sampling: 25 km
- cross-track scan

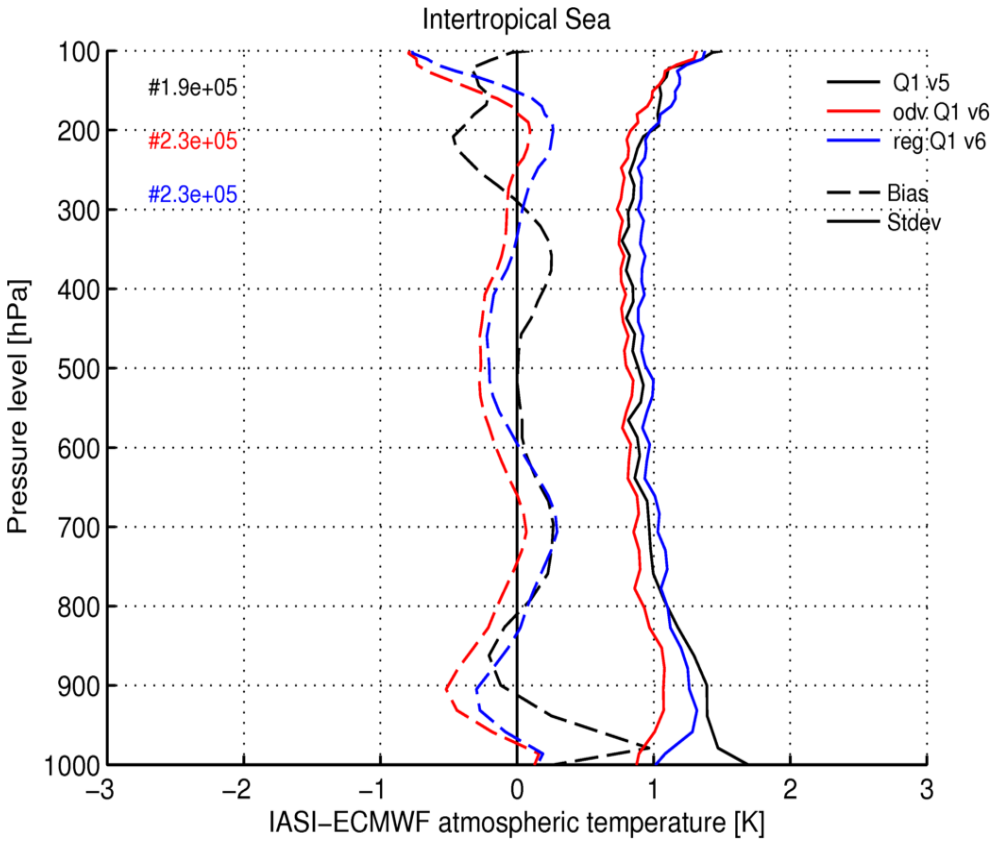
Breakthrough

- **Doubling of radiometric and spectral resolution of IASI for the benefit of weather forecast and atmospheric composition**
  - 75% more information in temperature profiling, particularly PBL
  - 30 % more information in water vapour profiling
  - Quantification of trace gases which are currently only detected
  - Vertical resolution of trace gases instead of columnar amounts only

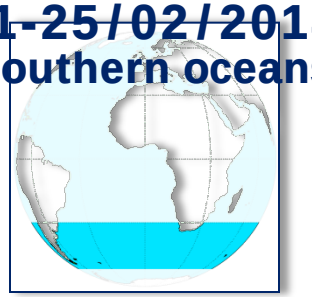
Atmospheric Profiling

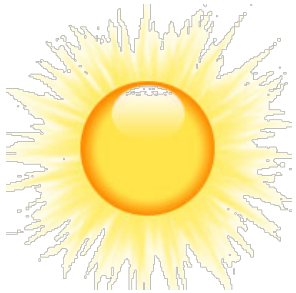
Hyperspectral Infrared L2 - IASI L2 v6 Temperature vs ECMWF ANA





21-25/02/2014
Southern oceans



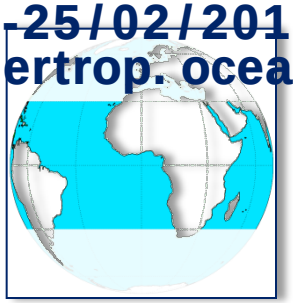


Q1 PPF v5

Q1 OEM v6

Q1 First Guess v6

21-25/02/2014
Intertrop. oceans



Results: T. August, M. Crapeau, T. Hultberg, X. Calbet

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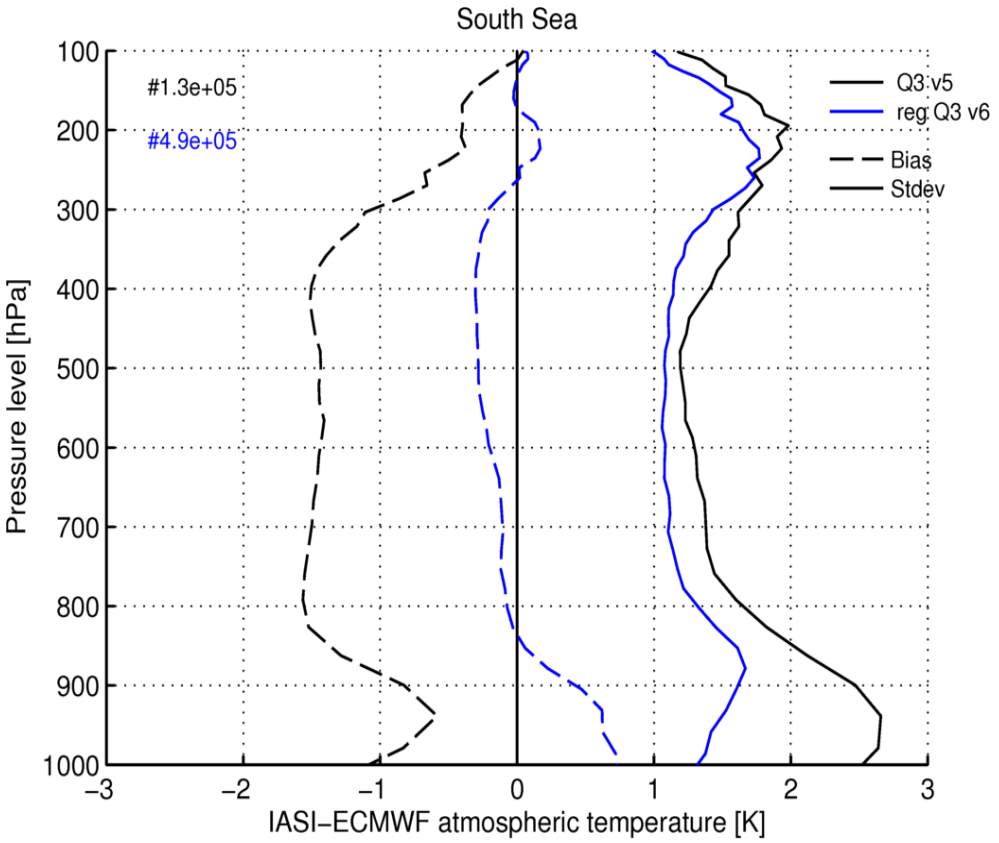
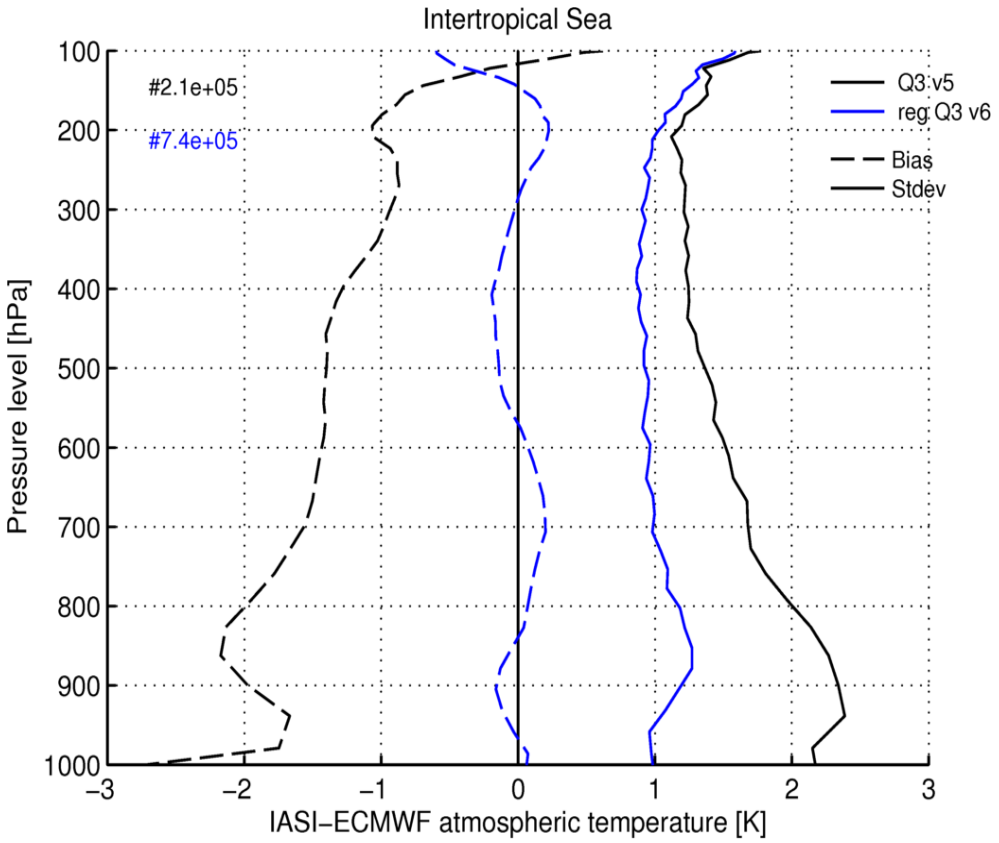
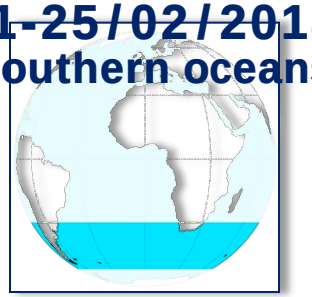
Atmospheric Profiling

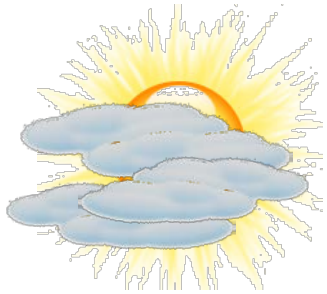
Hyperspectral Infrared L2 - IASI L2 v6 Temperature vs ECMWF ANA





21-25/02/2014
Southern oceans

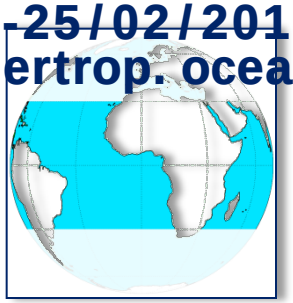




Q3 PPF v5

Q3 First Guess v6

21-25/02/2014
Intertrop. oceans



Results: T. August, M. Crapeau, T. Hultberg, X. Calbet

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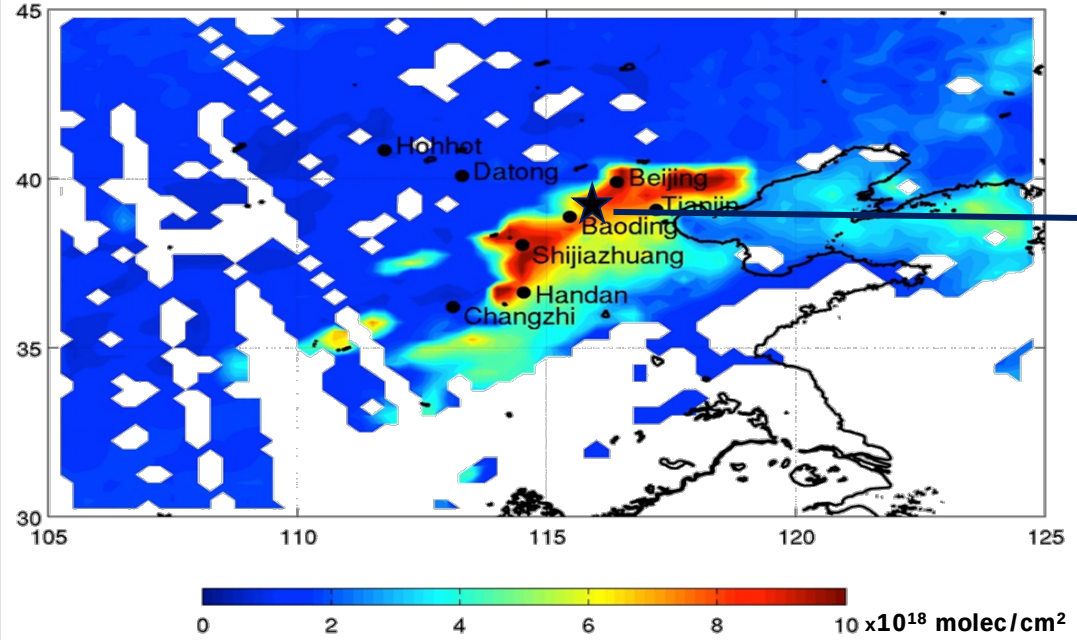
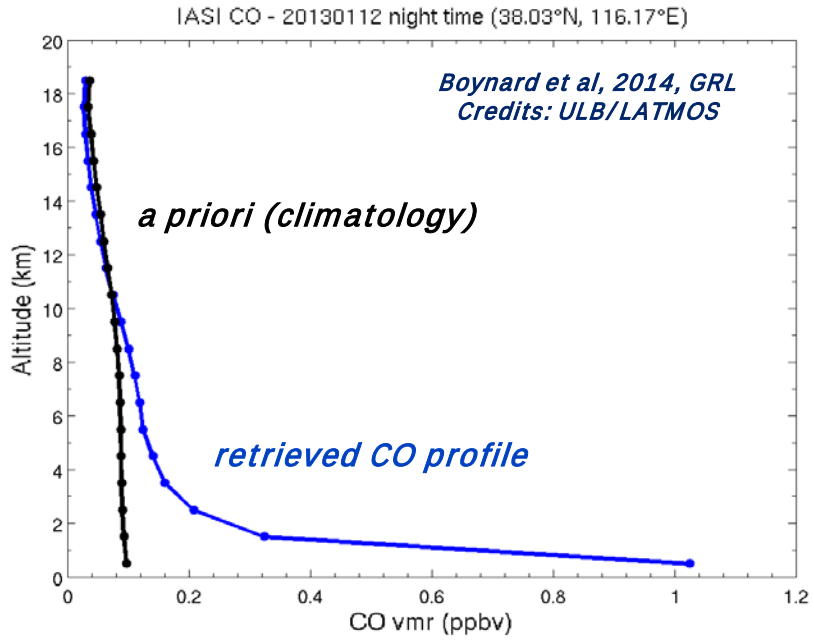
Towards a IASI CO Profile product: a premiere

CO Total column - Pollution over China, 12 January 2013





The IASI L2 processor v6 implements the FORLI-CO algorithm developed at ULB/LATMOS (O3M-SAF CDOP-2)

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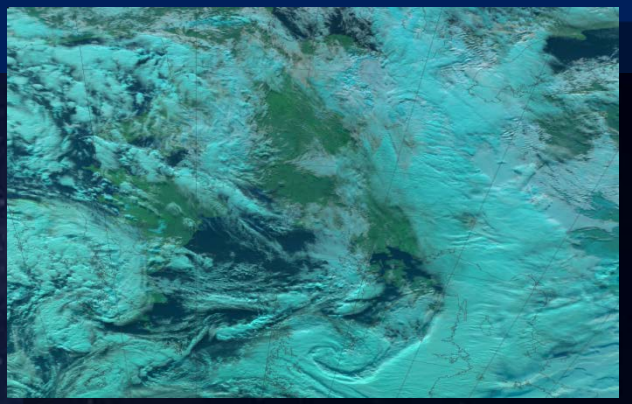
Optical imaging
METimage



- **Objectives**
- Hi-res cloud products, incl. microphysics
- Aerosols
- Polar AMVs
- Vegetation, snow, fire
- Sea/ice/land surface temperature
- Support to sounding missions

- **Implementation**
  - Development of *METimage* by DLR
- **Key performances**
- 20 channels: 0.443 – 13.345 µm
- absolute calibration: 5% (short-wave)
- 0.5 K (long-wave)
- radiometric sensitivity:
- SNR 60 – 500 (short-wave)
- 0.05 – 0.2 K (long-wave)
- spatial sampling: 500 m
- cross-track scan

Breakthrough

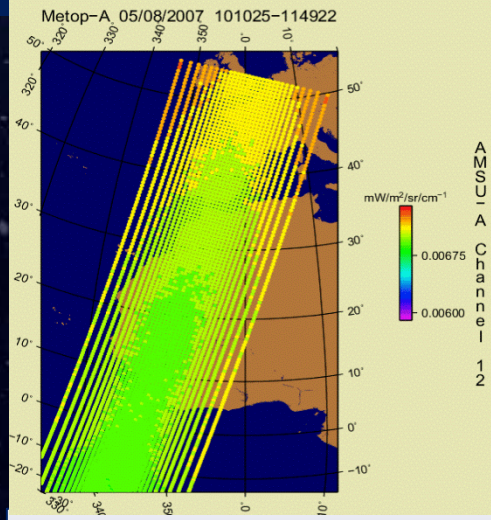
- **Far more spectral channels than AVHRR for the benefit of measuring more variables**
- **Higher spatial resolution (500 m):**
  - more complete coverage through greater likelihood to measure surface variables in partly cloud conditions
- **Better radiometric resolution for more accurate quantification of many variables**

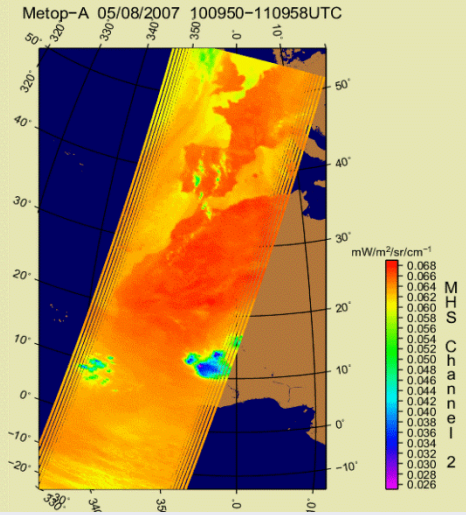
Microwave Sounding

- **Objectives**
- Temperature/humidity profiles in clear and cloudy air
- Cloud liquid water total column
- Imagery: precipitation

- **Implementation**
  - ESA development

- **Key performances**
- 24 channels: 23.8 – 229 GHz
- absolute calibration: 0.5 K
- radiometric noise: 0.2 – 1.6 K
- footprint size: 17 – 40 km
- cross-track scan





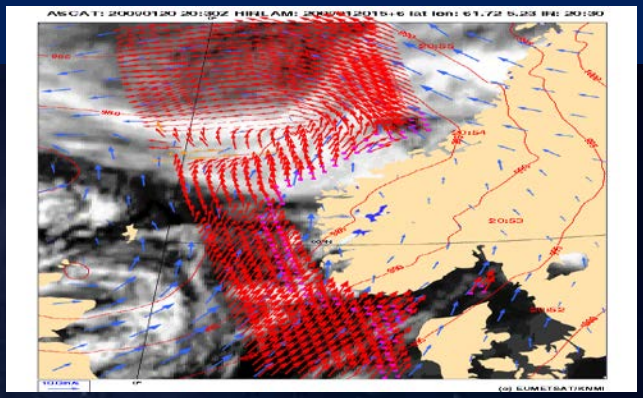
Breakthrough

- **Addition of a quasi-window channel at 229 GHz (recommended by ITSC-11)**
  - Cirrus cloud information giving a better humidity retrieval performance

- **Addition of sounding channels**
  - **+ 2 channels at 53-54 GHz**
  - **+ 3 channels at 183.31 GHz**

  - More information on temperature and water vapour profiles

Scatterometry



- **Objectives**
  - ocean surface wind vectors
  - soil moisture
  - snow equivalent water
  - sea-ice type
- **Implementation**
  - ESA development
- **Key performances**
  - C-band carrier frequency
  - VV + VH polarisation
  - measurement range: 4 – 40 m/s
  - Radiometric resolution: 3%
  - spatial resolution: 25 km
  - dual swath: 550 km each

Breakthrough

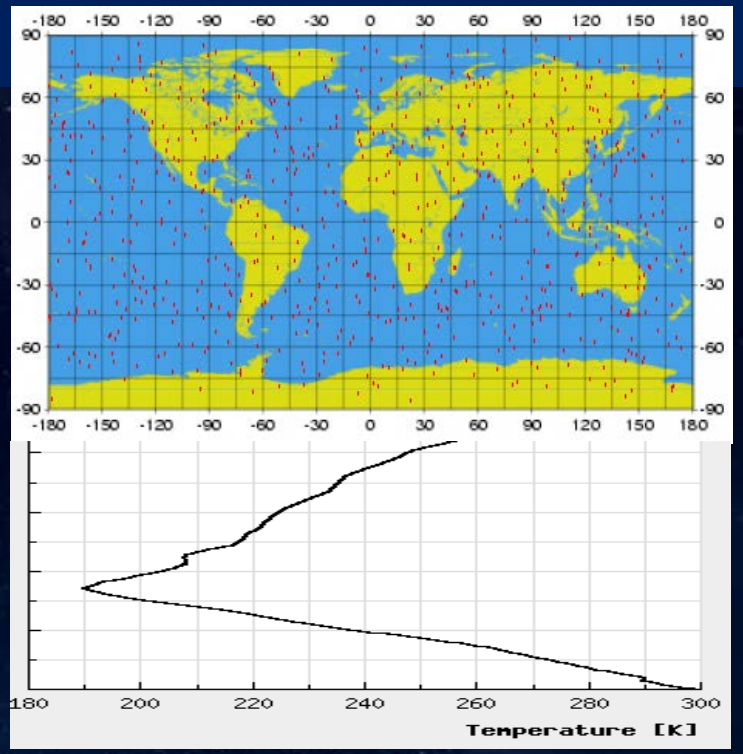
- **Increase of spatial resolution to 25 km**
  - Better approach of coast lines
- **Increase of swath width to >1100 km**
  - Enhanced coverage
- **Addition of VH polarisation**
  - Covers higher wind speeds without saturation, will benefit observation of tropical and extra-tropical storms

Radio-Occultation

- **Objectives**
- Refractivity profiles at high vert. resolution
- Temperature / humidity profiles
- PBL top and tropopause height
- Ionospheric electron content

- **Implementation**
- ESA development

- **Key performances**
- tracking of GPS and Galileo satellites
- optional: GLONASS and COMPASS
- RO on two satellites: > 2600 occultations per day
- bending angle accuracy: 0.5 µrad or 0.2%



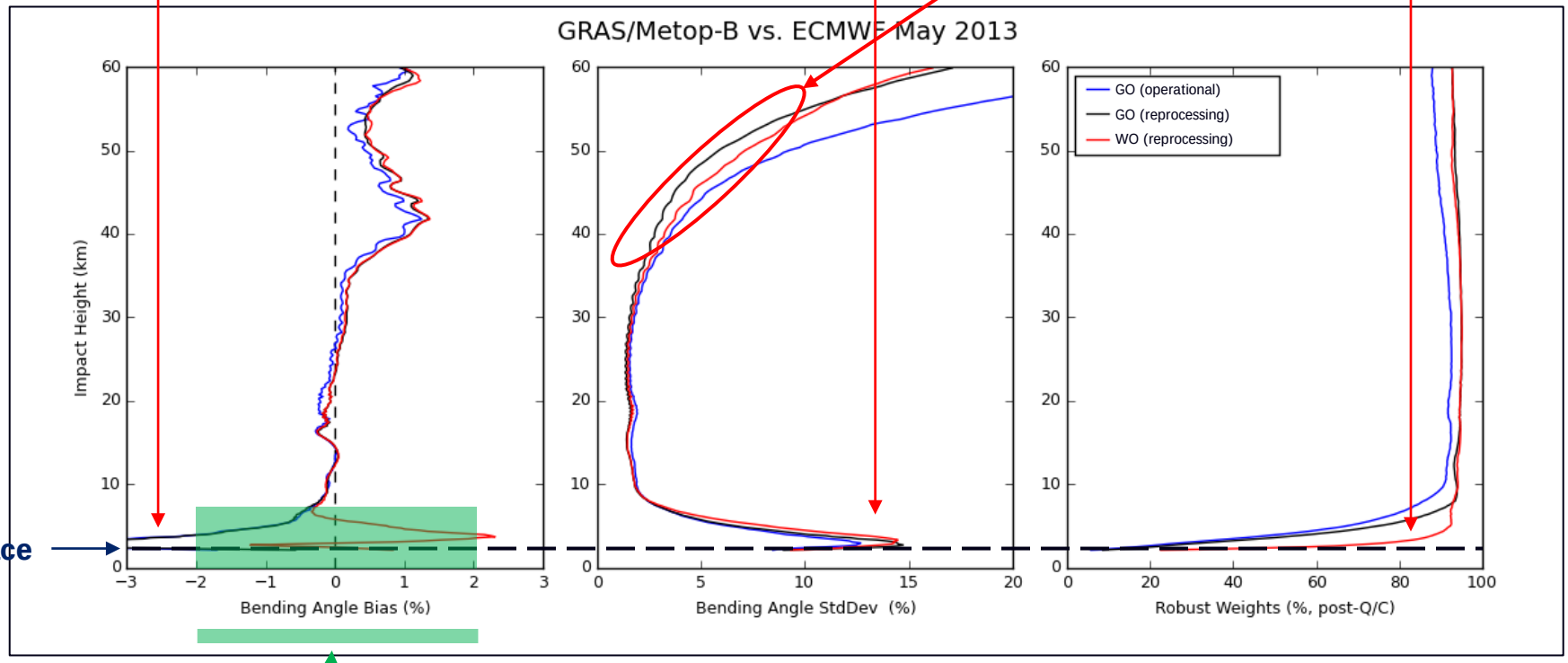
Breakthrough

- **Tracking of GPS and Galileo satellites to double the number of occultation measurements**
- **Equipment of both Metop-SG satellites with RO in case of a dual satellite configuration**

Scientific development for future / enhanced products
Wave optics for retrieval of GRAS profiles

- **Wave optics gives more data in the lowest 5 km…**
- **…without increasing stdevs…**
- **negative biases of GO removed**

Under investigation; can be improved



Surface

Uncertainty in NWP reference data

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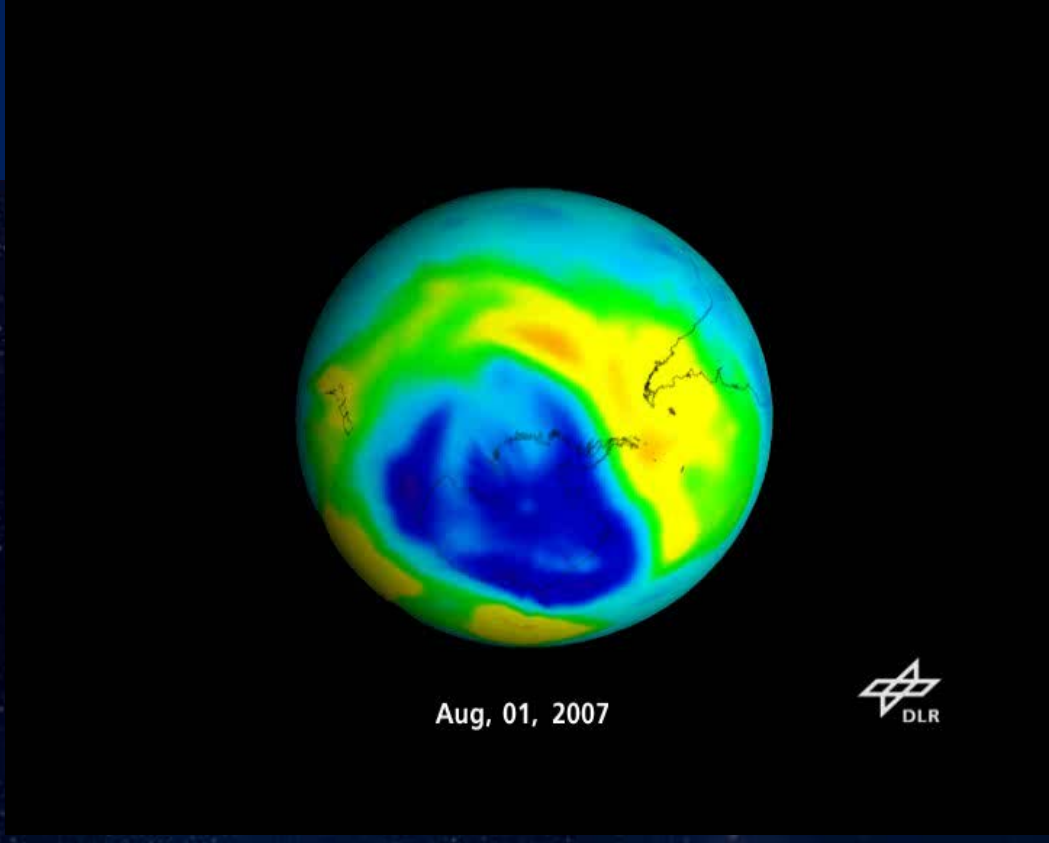
UVNS Nadir Viewing
UV/VIS/NIR/SWIR sounding

- **Objectives**
- Ozone profile and column
- Columns of CO_2,SO_2, NO_2, H_2O, CO, CH_4,
- Aerosol optical depth
- Columns of BrO, HCHO, OCHCHO
- Volcanic Plumes
- **Implementation**
  - GMES Sentinel-5 to be embarked
  - on Metop-SG, ESA development
- **Key performances**
- spectral range: 0.27 – 2.385 µm
- spectral resolution: 0.25 – 1 nm
- radiometric calibration: 1 – 2%
- SNR: 120 - 1500
- spatial sampling: 7 km
- Cross-track scan



Breakthrough

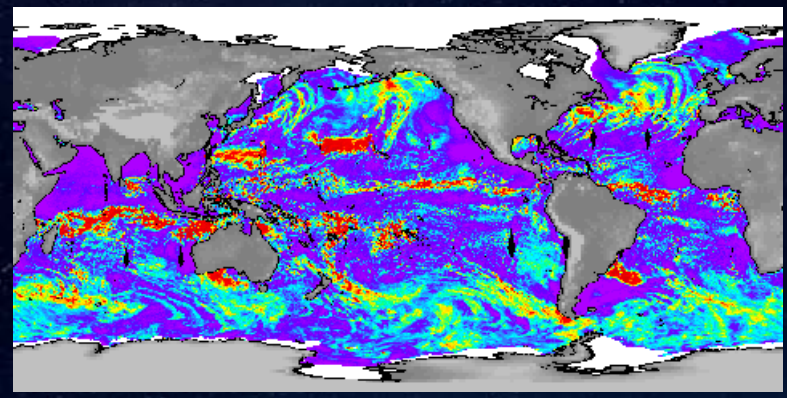
- **Drastically increased spatial sampling (7 km)**
  - for the benefit of air quality monitoring
- **Extended spectral range into the near and shortwave infrared regions**
  - to measure aerosols as well as methane and carbon monoxide in the PBL

Microwave Imaging

- **Objectives of a new mission**
  - precipitation and cloud products
  - water vapour profiles and imagery
  - sea-ice, snow, sea surface wind

- **Implementation**
  - ESA development

- **Key performances**
  - 18 channels: 18.7 – 183 GHz
  - dual polarisation (V, H) up to 89 GHz
  - V polarisation at higher frequencies
  - radiometric accuracy: 1 K
  - radiometric sensitivity: 0.6 – 1.2 K
  - Footprint size: 10 – 50 km
  - spatial sampling: 7 km
  - conical scan



Breakthrough: 18 channels

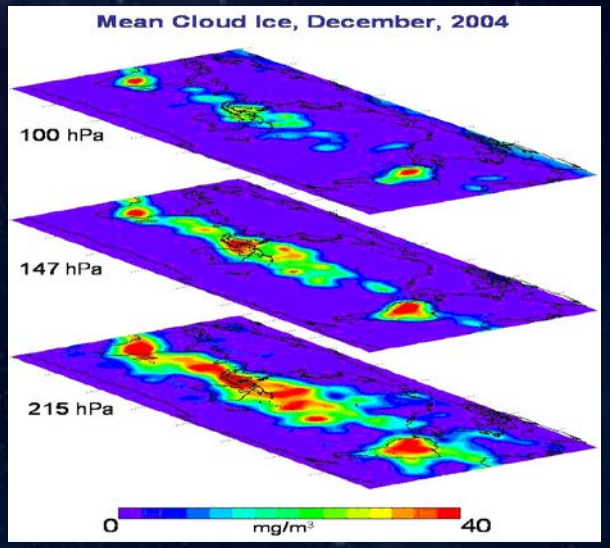
- **Continuity of key microwave imager channels for weather forecast**
- **Inclusion of dedicated sounding channels (118.75 GHz)**
  - Enhanced precipitation measurements through inclusion of dedicated sounding channels
- **Extended suite of 183.31 GHz channels**
  - water-vapour and cloud profiling

Ice Cloud Imaging

- **Objectives of a new mission**
- Cloud products, in particular ice clouds
- Snowfall detection and quantification
- Water-vapour profiles and imagery

- **Implementation**
  - ESA development

- **Key performances**
- 11 channels: 183 – 664 GHz
- single polarisation (V) for all channels
- dual polarisation (V, H) at 243 and 664 GHz
- radiometric accuracy: 1 – 1.5 K
- radiometric sensitivity: 0.6 – 1.9 K
- Footprint size: 15 km
- spatial sampling: 7.5 km
- conical scan

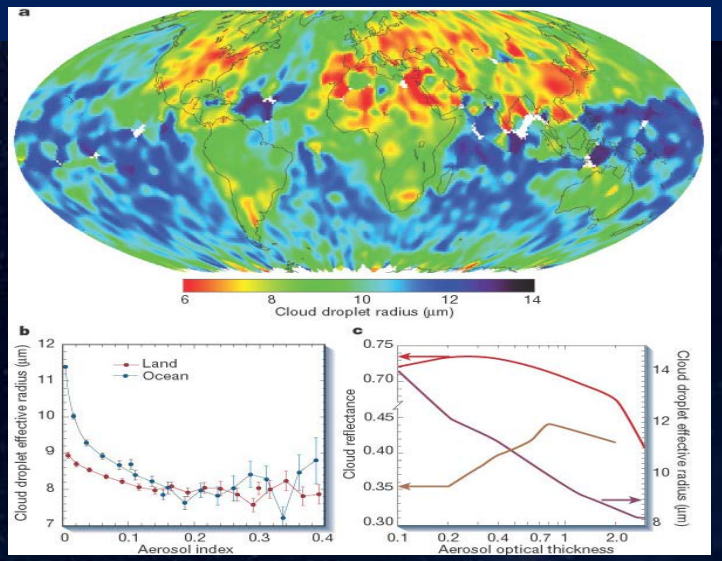


Breakthrough: 11 channels

- **Establishes operational ice-cloud imaging mission**
- **Support of weather forecast, hydrology, and climate monitoring**

Multi-viewing multi-channel multi-polarisation Imaging

- **Objectives of a new mission**
- Aerosol – optical thickness, particle size, type, height, absorption
- Volcanic Ash
- Cloud phase, height, optical depth
- Surface albedo



Kaufman et al. (2002)

- **Implementation**
  - ESA development

- **Key performances**
- 12 channels: 0.41 – 2.13 µm
- 3 polarisations: 0°, 60°, -60°
- 14 views
- radiometric bias: 3%
- SNR: 200
- spatial sampling: 4 km
- push-broom scan (2200 km swath)

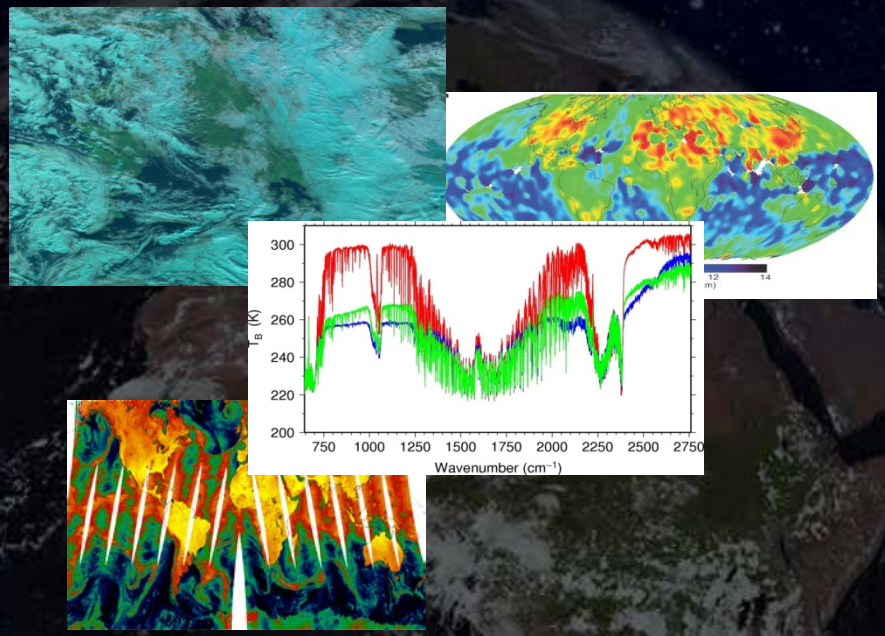
Breakthrough:

- **Enhanced spatial sampling (4 km)**
  - Improves separation of cloudy areas
- **12 spectral channels (9 polarised), extending into the UV and SWIR**
  - Better aerosol characterisation
- **Higher angular resolution (14 views)**
  - Better phase function characterisation

EPS Second Generation
Synergy of observation missions

Observation missions are highly complementary

- Co-registration of measurements will allow to optimise the information extraction
- Synergy to be considered in payload distribution of a dual satellite configuration

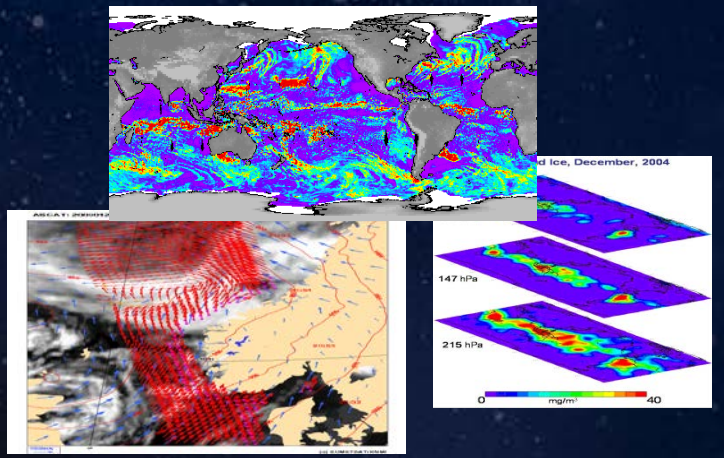


Essential co-registrations

- IAS – VII – UVNS
- MWI - ICI

Desired co-registrations

- IAS – MWS
- VII – 3MI
- IAS – UVNS – 3MI
- MWI – SCA – VII



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Process for user requirements elaboration

Users

Approves user list

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User Needs

Know / translate

Can't always formulate

Approves

Should drive

Guide

Discuss / endorse

User Workshop

User Requirements

Formulate

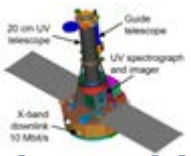
Experts

Trigger / justify evolution

Open possibilities

Constrain the fulfilment

Are not always aware of



Technological Capabilities

Consider

User Preparation: MTG as an example

- A dedicated project in EUMETSAT
  - Including representatives from the Member States
- MTGUP Project objectives are to:
  - Support users in a smooth transition from Meteosat Second Generation (MSG) to MTG for all comparable services, noting that the MSG and MTG availability may have a longer period of overlap;
  - Assist users in the early adoption of MTG services into operational forecasting;
  - Assist and encourage users to take advantage of the new services and capabilities offered by MTG in the early stages of MTG operations;
  - Establish a communication platform for the exchange of user feedback on MTG Programmatic and general user preparation issues.

User Preparation: Schedule

- Once established, the project will continue until the start of MTG-I2 operations + 1 year to cover the transition and the early operations phases, until such time when the full MTG services are in place;

- The various project phases and milestones shall be linked to the availability of the future MTG services (0 degree, RSS, Sounding).

- Consider operational transition scenarios

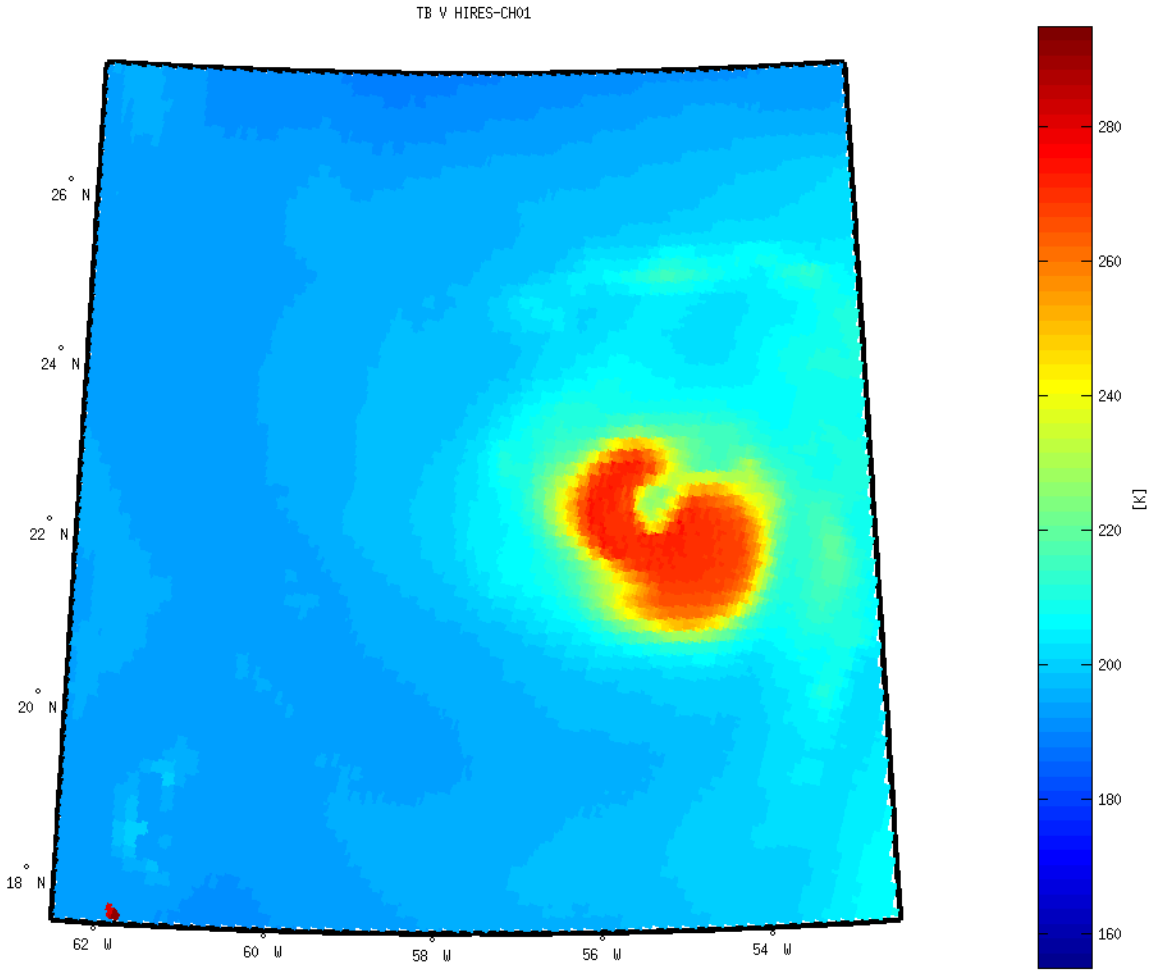
User Preparation: Work packages

- Establish and validate user expectations
- Ensure User engagement
- Monitor user preparedness
- Training Support
- Communication and information!

User Preparation: Work packages

- Test Data Support
- Science interaction and collaboration
  - Science studies and activities supporting the new capabilities of MTG, e.g. NWC-IRS Demonstration project
  - Research Announcement Collaboration, etc.,
  - Review the portfolio of existing meteorological products
  - Propose enhancements to the existing products based on changing user requirements
- Build on experiences from our partners
  - US/Europe collaboration is exemplary!!

Test Data: MWI-1 HiRes



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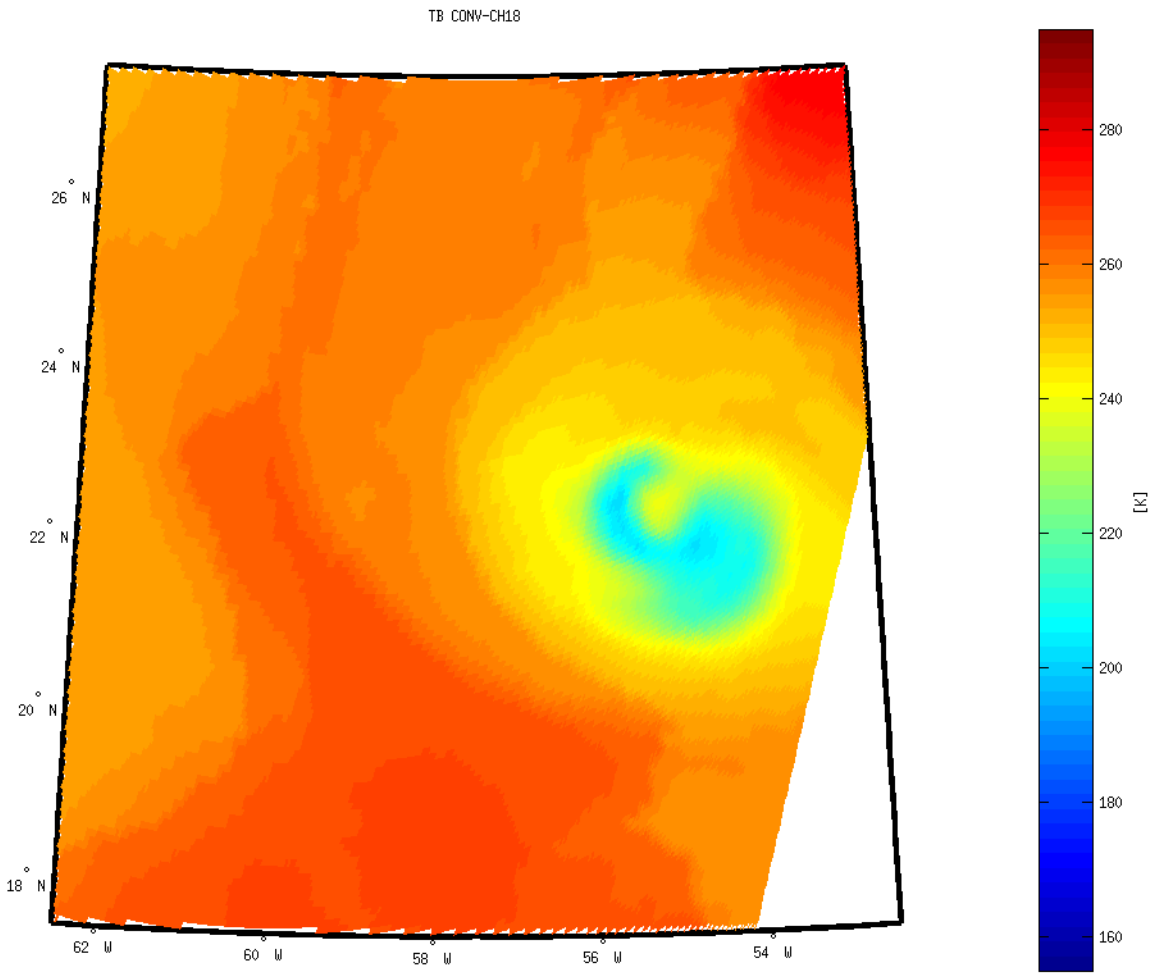
Test Data: MWI Channels 1 - 18

Channel	Frequency (GHz)
MWI-1	18.7
MWI-2	23.8
MWI-3	31.4
MWI-4	50.3
MWI-5	52.610
MWI-6	53.24
MWI-7	53.750
MWI-8	89.0
MWI-9	118.7503±3.20
MWI-10	118.7503±2.10
MWI-11	118.7503±1.4
MWI-12	118.7503±1.2
MWI-13	165.5±0.75
MWI-14	183.31±7.0
MWI-15	183.31±6.1
MWI-16	183.31±4.9
MWI-17	183.31±3.4
MWI-18	183.31±2.0



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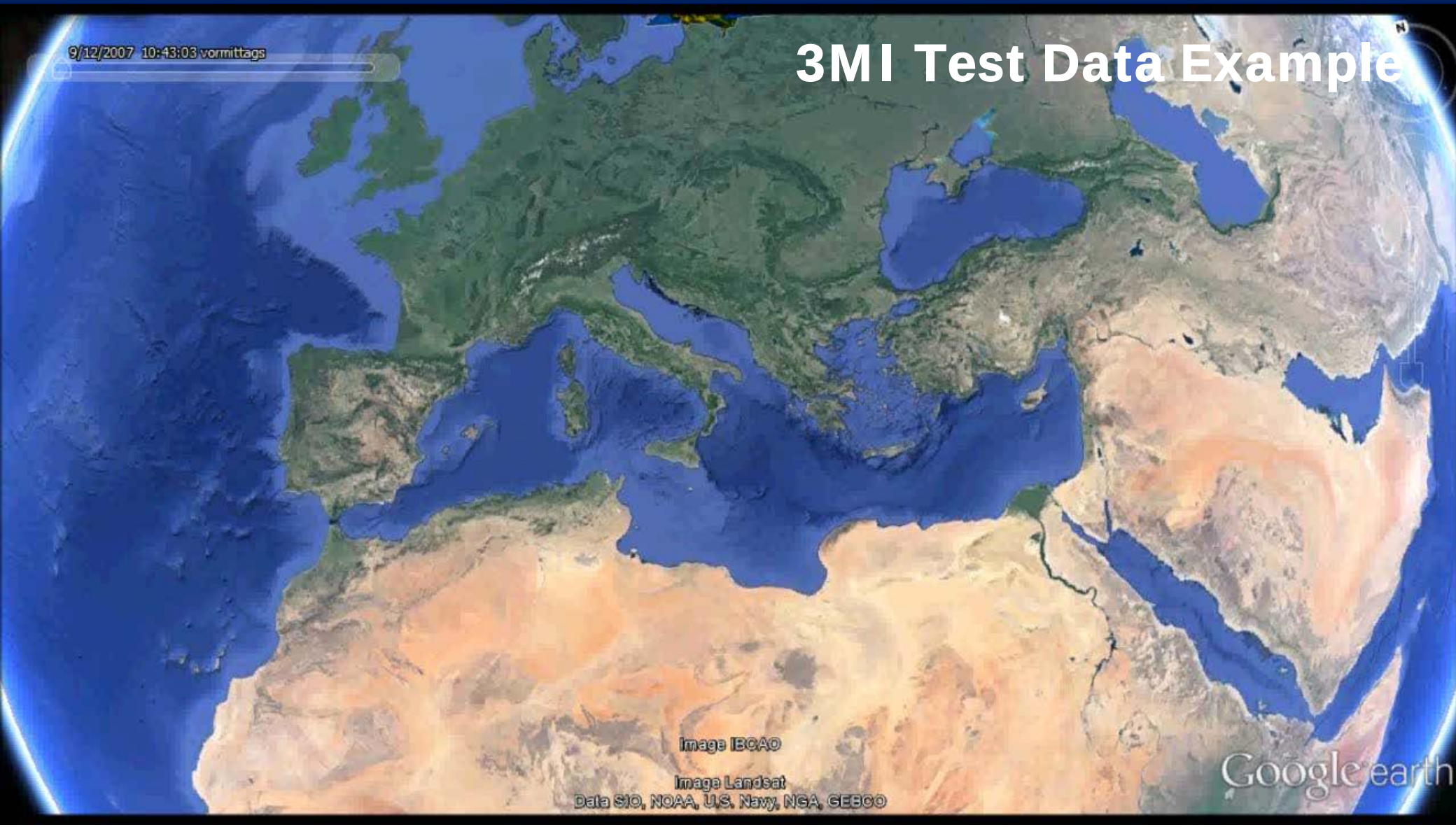
Thank You – Any Questions



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Thank You For Inviting Me!
Questions?

NOAA NESDIS STAR

JPSS-STAR (JSTAR) PROGRAM MEETING OBJECTIVES, AGENDA, AND JSTAR OVERVIEW

PRESENTED BY LIHANG ZHOU
JPSS AMP DEPUTY FOR SCIENCE & JPSS STAR PROGRAM MANAGER

SESSION 1, AUGUST 8TH, 2016

CONTRIBUTIONS FROM MURTY DIVAKARLA, XINGPIN LIU
TOM ATKINS, TESS VALENZUELA
MEMBERS OF JPSS STAR SCIENCE TEAMS
JPSS PROGRAM SCIENCE
JPSS ALGORITHM MANAGEMENT PROJECT (AMP)
ARE THANKFULLY ACKNOWLEDGED

Meeting Objectives

1. Review the progress of the STAR JPSS program over the past year and since launch and review the plans in the coming year, particularly as they relate to J1 pre- and post-launch activities

2. Engage with users supporting the NOAA mission and other stakeholders such as NASA, DOD, OSPO, OSGS, NCEI, JPSS Risk Reduction and Proving Ground, the JPSS Ground and Flight Segments, and industry partners

3. Review the outcomes from the JPSS Enterprise Algorithm meeting and the JPSS Reprocessing Meeting

4. Enhance interaction between SDR and EDR teams and facilitate science and technical exchanges among the teams

5. Host the GSICS User Workshop, which will include an introduction to existing GSICS research and products, and discussion of new planned products

Comments: Please submit the RFA form or email to: Lihang.Zhou@noaa.gov

Highlights of JSTAR FY16 Accomplishments

- **JPSS-1 Readiness:**
  - **Delivery of JPSS-1 Cal/Val Plan**: Dec-15
  - **Developed, tested, and delivered J1 algorithms for ATMS, CrIS, VIIRS, and OMPS SDRs**:
    - » Delivery of Pre-Launch Characterization Packages
    - » Delivery of algorithms and PCT/LUTs updates based on TVAC
    - » J-1 Launch Ready LUTs with mounting Coefficients
  - **Support JPSS Ground Project Block 2.0 Testing** (SDRs, Imagery, GCOM, VI, Aerosols, Active Fire, etc)

- **S-NPP Maintenance/Updates:**
  - **VIIRS Global Surface Type** (GST) Annual update: available on STAR FTP: Dec-15
  - **VIIRS LSA EDR LUT Update**; DAP delivered: Apr-16

- **Enterprise Algorithms & Reprocessing:**
  - **Enterprise Clouds, Cryosphere, and Aerosol**: DAP delivered: Dec-15; Updated DAP: Jun-16
  - **NUCAPS Phase 4 (CrIS Full Spectral Resolution)** CDR: Feb-16
  - **Delivered new VIIRS Active Fire product in NDE Operations**, TTO Mar-16
  - **Enterprise Ozone Total Column EDR DAP delivered**: Mar-16
  - **NOAA MSL12 VIIRS Ocean Color science quality mission long data** files released through the CoastWatch FTP server: Jun-16; **ACSPO SST** in ops, fully val., archived, reprocessing demonstrated
  - **SDR Reprocessing infrastructure has been established**

- **Integrated Calibration/Validation System (ICVS) Long Term Monitoring:**
  - **ICVS**: Transitioned to GRAVITE to support operation; Upgraded for J1
  - **EDR Long Term Monitoring** Site Phase I Completed: Jul-16

- **Work with Program Science and coordinate reviews of requirements; waivers; and future improvements**

JPSS-1 Algorithm Updates (Delivered)

Milestones	Delivery Date
CrIS SDR: Full spectral resolutions SDR	**Jan-15**
CrIS SDR: Fringe Count Error module update	**Jun-15: Apr-16**
CrIS SDR: JPSS-1 Instrument Test Data Analysis Report	**Mar-15**
VIIRS SDR: JPSS-1 Instrument Test Data Analysis Report	**Mar-15**
OMPS SDR: JPSS-1 Instrument Test Data Analysis Report	**Jul-14**
OMPS SDR: Extended spectral range and HCS improvement	**Apr-15 (TC); May-15 (NP)**
Vegetation Indices: Add top-of-canopy NDVI	**Mar-15**
Ocean Color: OCC for coastal and inland water	**Apr-15**
Active Fires: 2D fire mask; include water for global coverage	**Jun-15**
Risk Reduction Algorithms (Aerosol, Clouds, Cryosphere)	**Jul-15; Dec-15; Jun-16**
ATMS SDR: JPSS-1 Instrument Test Data Analysis Report	**Feb-16**
VIIRS SDR: LUT and GEO code update for JPSS-1	**Aug-15; Nov-15**

JPSS-1 Algorithm Updates (cont.) (Delivered)

Milestones	Delivery Date
VIIRS Sector Rotation Quality Flag Correction	**May-16**
ATMS SDR: PCT update based on sensor characterization	**Jun-16**
ATMS SDR: S/C Sensor Mounting Coefficients	**Jul-16**
CrIS SDR: S/C Sensor Mounting Coefficients	**Jun-16**
VIIRS GEO code for RTA/HAM start encoder nominal	**Apr-16**
VIIRS SDR: J1 Launch Ready LUTs	**Jul-16**
VIIRS SDR: S/C Sensor Mounting Coefficients	**Jul-16**
OMPS SDR: LUTs for S-NPP Block 2.0	**Mar-16**
OMPS SDR: J1 Launch Ready LUTs	**Mar-16 (Final Jul-16)**
OMPS SDR: S/C Sensor Mounting Coefficients	**Jul-16**
OMPS EDR: Enterprise Total Ozone Algo (V8TOz) to NDE	**Mar-16**

Algorithm and Table Updates Needed for JPSS-1 Operational Readiness are Complete

JPSS Team Publications

Product Maturity
- Algorithm Maturity Matrix
- Data Maturity

Product Monitoring
- ICVS
- EDR LTM Site

Meetings & Reviews
- 2016 Meetings
- Meetings Archive

Product Applications
- Fort McMurray Fire
- Blizzard 2016
- Hurricane Iselle 2014
- Paraguay Flooding 2014

Product Teams

JPSS-1 Test Datasets

Links

Calendar Year	2012	2013	2014	2015	2016 YTD	Totals
Journal Articles	19	29	36	35	19	138

2016 YTD: 19

Choi, T., Shao, X., Cao, C., & Weng, F. (2016). Radiometric Stability Monitoring of the Suomi NPP Visible Infrared Imaging Radiometer Suite (VIIRS) Reflective Solar Bands Using the Moon. *Remote Sensing*, 8(1). [10.3390/rs8010015]

Datla, R., **Shao, X., Cao, C., & Wu, X.** (2016). Comparison of the Calibration Algorithms and SI Traceability of MODIS, VIIRS, GOES, and GOES-R ABI Sensors. *Remote Sensing*, 8(2). [10.3390/rs8020126]

Gladkova, I., Ignatov, A., Shahriar, F., **Kihai, Y., Hillger, D., & Petrenko, B.** (2016). Improved VIIRS and MODIS SST Imagery. *Remote Sensing*, 8(1), 79. [10.3390/rs8010079]

Hillger, D., Kopp, T., Seaman, C., Miller, S., **Lindsey, D.**, Stevens, E., Solbrig, J., Straka, W., III, Kreller, M., Kuciauskas, A., & Terborg, A. (2016). User Validation of VIIRS Satellite Imagery. *Remote Sensing*, 8(1). [10.3390/rs8010011]

Lee, S., & **Cao, C.** (2016). Suomi NPP VIIRS Day/Night Band Stray Light Characterization and Correction Using Calibration View Data. *Remote Sensing*, 8(2). [10.3390/rs8020138]

Liang, X. M., Ignatov, A., Kramar, M., & Yu, F. F. (2016). Preliminary Inter-Comparison between AHI, VIIRS and MODIS Clear-Sky Ocean Radiances for Accurate SST Retrievals. *Remote Sensing*, 8(3), 203. [10.3390/rs8030203]

Meng, F., Xin, J. Y., **Cao, C. Y., Shao, X.**, Shan, B. Y., & Xiao, Q. F. (2016). Seasonal Variations in Aerosol Optical Thickness over Eastern China Determined from VIIRS Data and Ground Measurements. *International Journal of Remote Sensing*, 37(8), 1868-1880. [10.1080/01431161.2016.1163750]

Obata, K., Miura, T., Yoshioka, H., Huete, A. R., & **Vargas, M.** (2016). Spectral Cross-Calibration of VIIRS Enhanced Vegetation Index with MODIS: A Case Study Using Year-Long Global Data. *Remote Sensing*, 8(1). [10.3390/rs8010034]

Shao, X., Cao, C., & Liu, T.-C. (2016). Spectral Dependent Degradation of the Solar Diffuser on Suomi-NPP VIIRS Due to Surface Roughness-Induced Rayleigh Scattering. *Remote Sensing*, 8(3). [10.3390/rs8030254]

Sun, J. Q., & **Wang, M.** H. (2016). VIIRS Reflective Solar Bands Calibration Progress and Its Impact on Ocean Color Products. *Remote Sensing*, 8(3). [10.3390/rs8030194]

Wang, W., & **Cao, C.** (2016). Monitoring the NOAA Operational VIIRS Rsb and DNB Calibration Stability Using Monthly and Semi-Monthly Deep Convective Clouds Time Series. *Remote Sensing*, 8(1). [10.3390/rs8010032]

Wang, Z., & **Cao, C. Y.** (2016). Assessing the Effects of Suomi NPP VIIRS M15/M16 Detector Radiometric Stability and Relative Spectral Response Variation on Striping. *Remote Sensing*, 8(2). [10.3390/rs8020145]

Weng, F., & Yang, H. (2016). Validation of ATMS Calibration Accuracy Using Suomi NPP Pitch Maneuver Observations. *Remote Sensing*, 8(4). [10.3390/rs8040332]

Xiao, Q., Zhang, H., Choi, M., Li, S., **Kondragunta, S.**, Kim, J., Holben, B., Levy, R. C., & Liu, Y. (2016). Evaluation of VIIRS, GOCI, and MODIS Collection 6aod Retrievals against Ground Sunphotometer Observations over East Asia. *Atmospheric Chemistry and Physics*, 16(3), 1255-1269. [10.5194/acp-16-1255-2016]

Yang, H., & **Weng, F.** (2016). Corrections for on-Orbit ATMS Lunar Contamination. *IEEE Transactions on Geoscience and Remote Sensing*, 54(4), 1918-1924. [10.1109/tgrs.2015.2490198]

Yu, F., & **Wu, X.** (2016). Radiometric Inter-Calibration between Himawari-8 AHI and S-NPP VIIRS for the Solar Reflective Bands. *Remote Sensing*, 8(3). [10.3390/rs8030165]

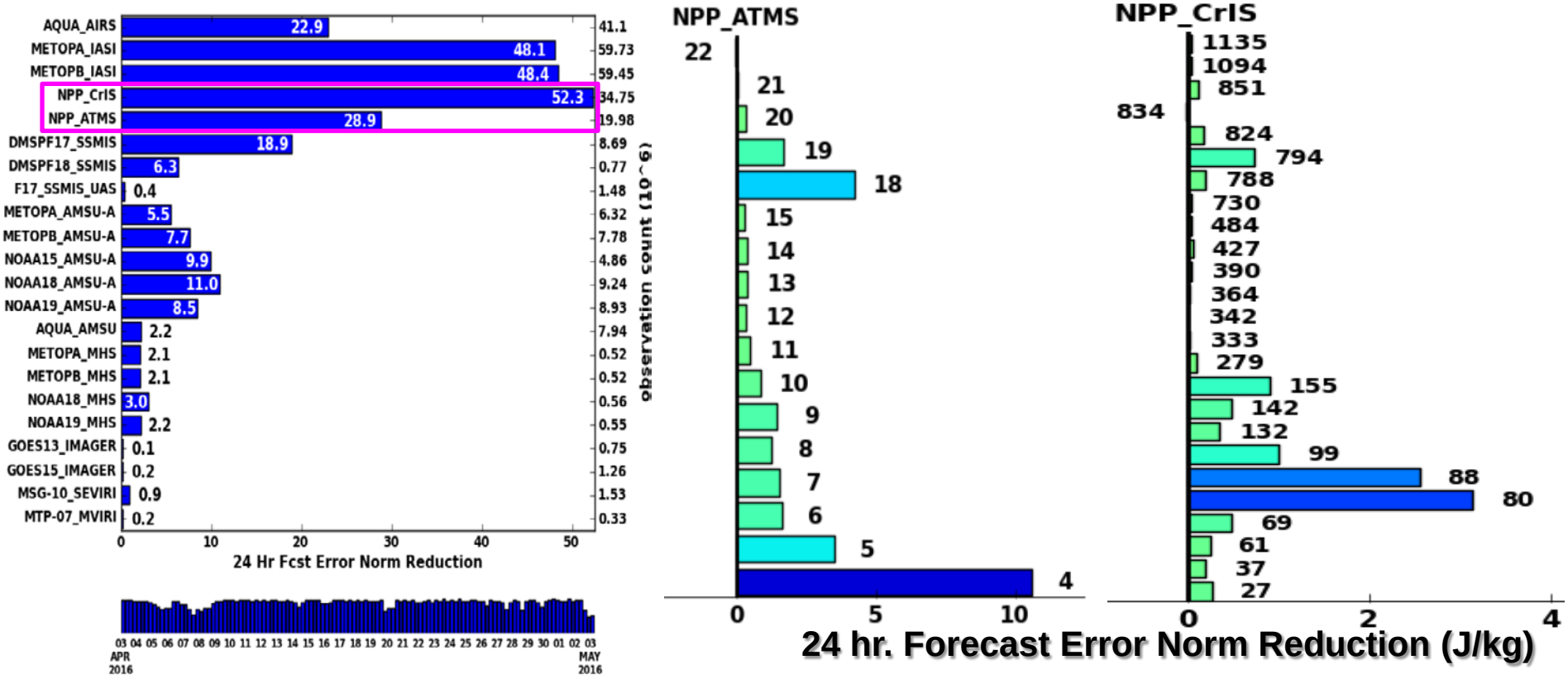
Zhang, R., Huang, C., **Zhan, X.**, Dai, Q., & Song, K. (2016). Development and Validation of the Global Surface Type Data Product from S-NPP VIIRS. *Remote Sensing Letters*, 7(1), 51-60. [10.1080/2150704x.2015.1101649]

Zhou, L. H., Divakarla, M., & Liu, X. P. (2016). An Overview of the Joint Polar Satellite System (JPSS) Science Data Product

NAVGEM Observation Impact

NAVDAS-AR Observation Sensitivity

Slide Courtesy: Bill Campbell (NRL)

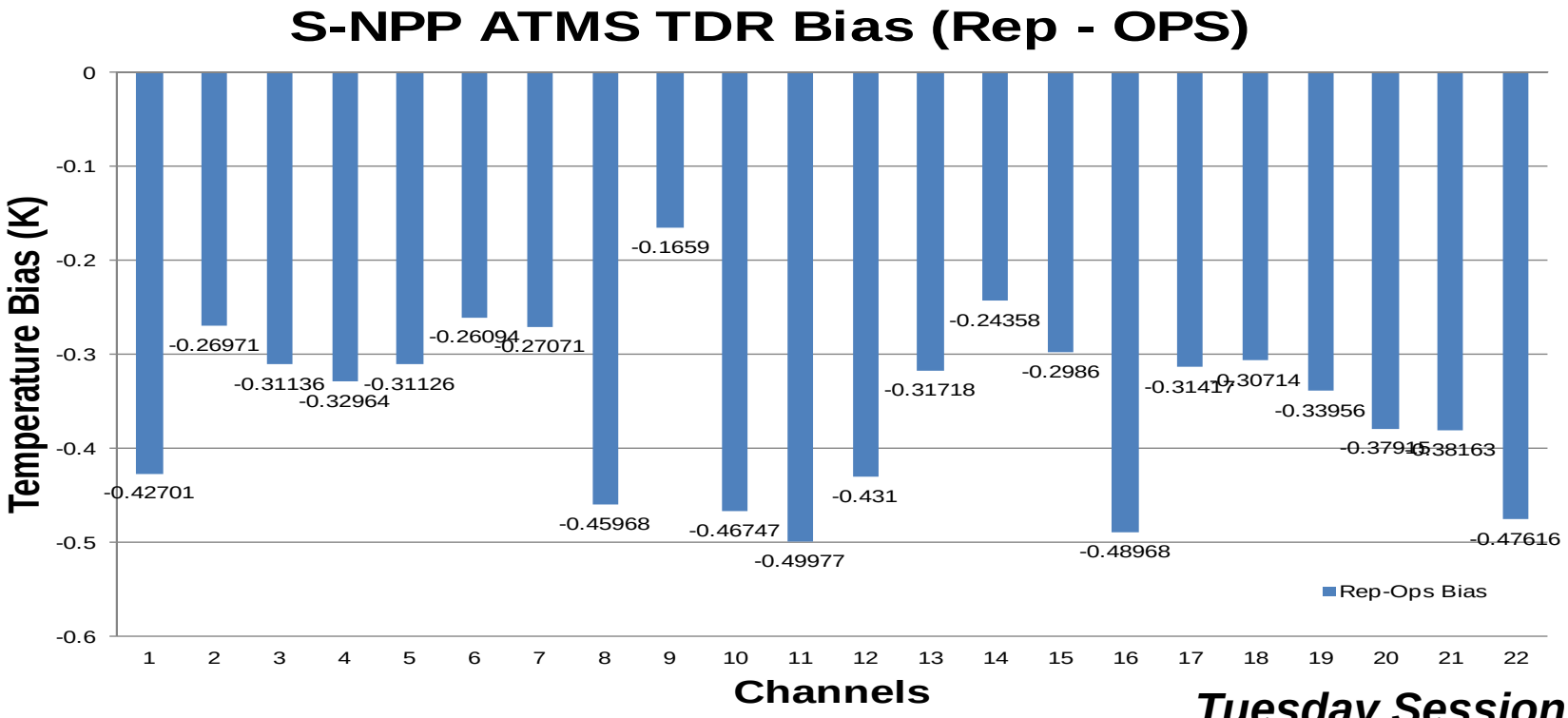


Hyperspectral Infrared Sounders (.e.g. CrIS) and Advanced Microwave Sounders (e.g. ATMS) are the top two contributors for reducing forecast errors.

J1 ATMS SDR/TDR Algorithm Improvements

ATMS Lead: Fuzhong Weng

- ✓ Radiance based calibration algorithm
- ✓ Physical model based Lunar contamination correction algorithm
- ✓ Allan variance NEdT evaluation algorithm
- o Physical model based antenna emissivity correction



Tuesday Session 4

Microwave Integrated Retrieval System (MIRS)

(http://mirs.nesdis.noaa.gov/)

MIRS Lead: Mark Liu

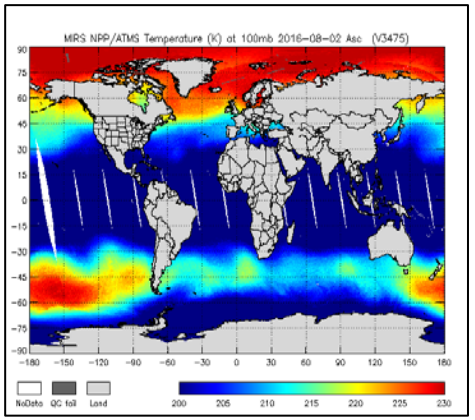
MIRS Official Products
MiRS (v11.1)

1. Temperature profile
2. Moisture profile
3. TPW (global coverage)
4. Surface temperature
5. Emissivity spectrum
6. Surface Type
7. Snow Water Equivalent (SWE)
8. Effective snow grain size
9. Snow Cover Extent (SCE)
10. Sea Ice Concentration (SIC)
11. Multiyear (MY) Type SIC
12. First year (FY) Type SIC
13. Cloud Liquid Water (CLW)
14. Ice Water Path (IWP)
15. Rain Water Path (RWP)
16. Rainfall Rate
17. Snow Fall Rate

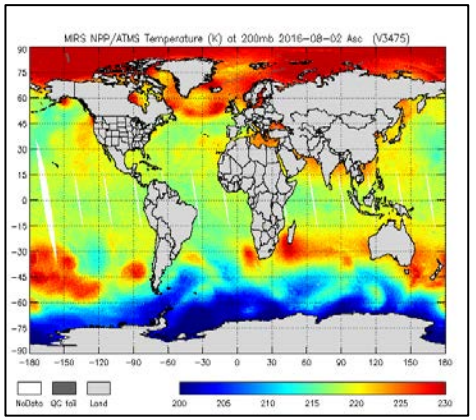
Products being investigated Experimental and getting validated

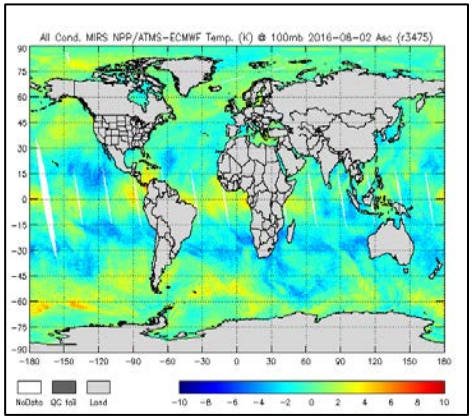
1. Cloud profile
2. Rain profile
3. Atmospheric Ice profile
4. Snow Temperature (skin)
5. Sea surface temperature
6. Wind speed

MIRS/ATMS T(p) 100mb

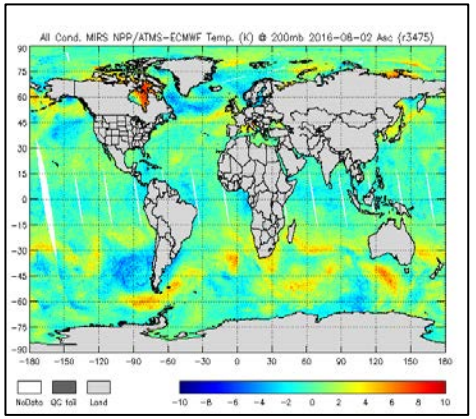


MIRS/ATMS T(p) 200mb





100mb T(p) Diff with ECMWF



200mb T(p) Diff with ECMWF

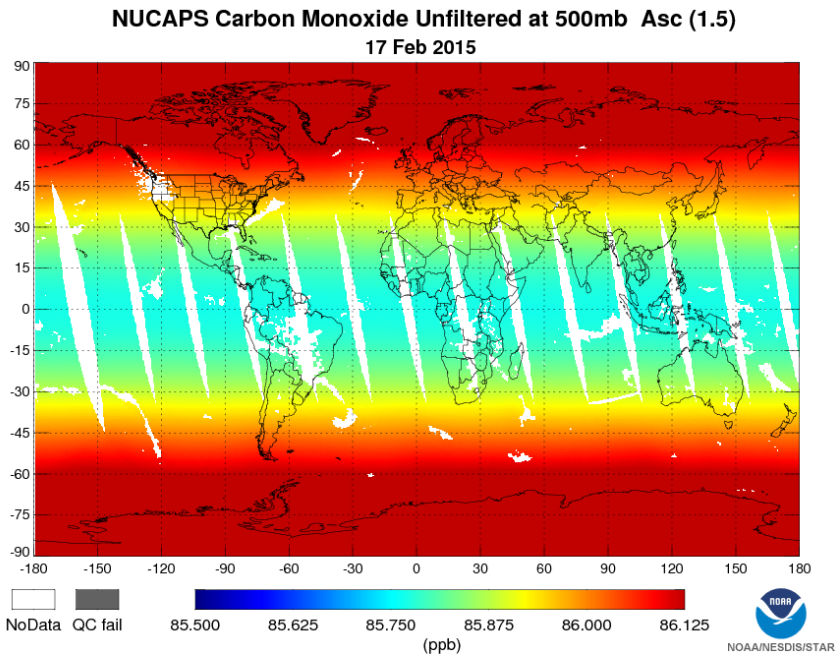
Slide Courtesy Christopher Grassotti

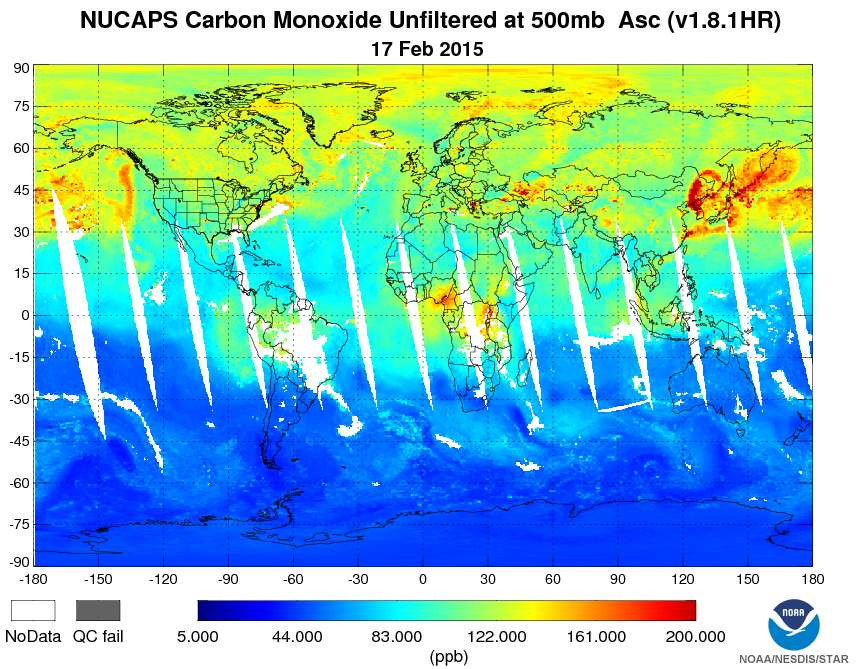
Wed. Session 6

J1 CrIS Algorithm/Software FSR SDR

CrIS SDR Lead - Yong Han; NUCAPS Lead – Mark Liu; EDR; AIT Lead – Walter Wolf

- STAR CrIS SDR processing system routinely generating FSR SDR since 12/4/2014;
- **NWP centers worldwide routinely access FSR SDRs from STAR FTP servers**
- Operational J1 Algorithm evaluation displayed expected results





NUCAPS Trace Gas Experimental Product: CO
(Normal resolution-Left; Full Resolution Right)

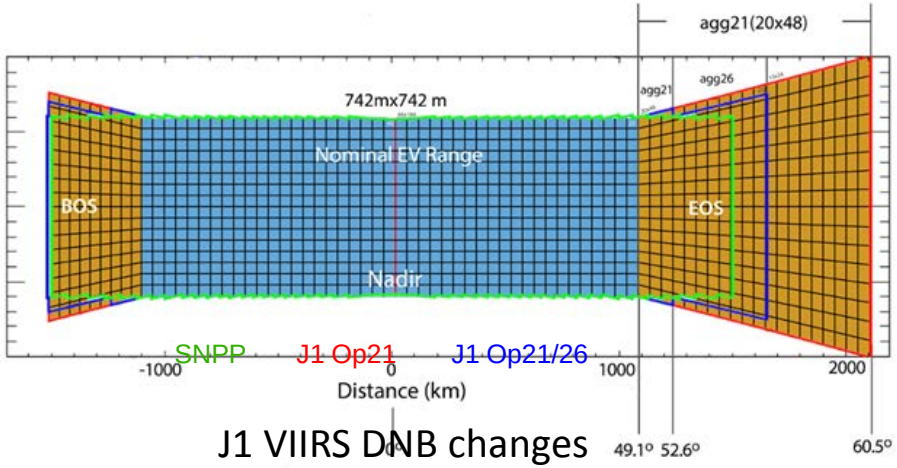
Tues. Session 4
Wed. Session 6
Thur. Session 11

J1 VIIRS Waivers Reviewed
SDR Mitigation Developed and Delivered

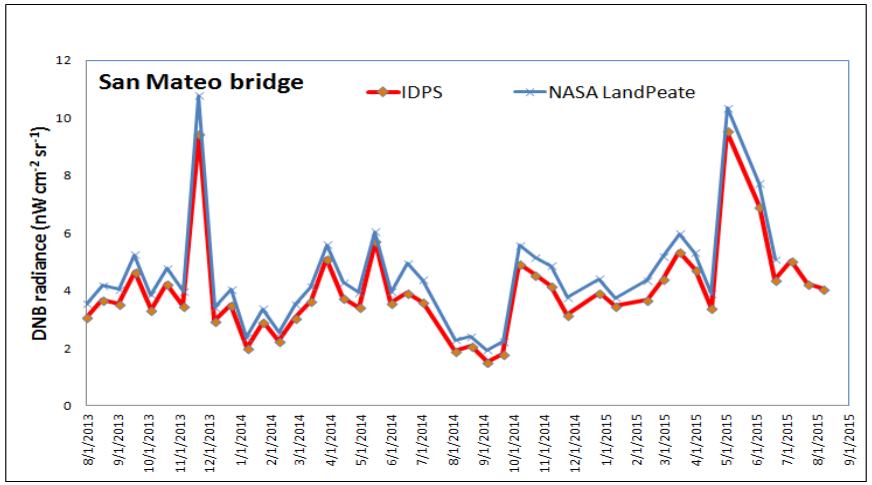
VIIRS Lead Changyong Cao

- Developed, tested, and delivered J1 SDR algorithms upgrades mitigating certain instrument waivers (e.g. DNB Aggregation modes 21, 21/26 GEO, LUT and code changes)

- On-going STAR research capabilities for an implementation post-launch
  - DNB other agg modes (Agg21/26; dual calibration; pixel based cal. etc.)
  - SWIR nonlinearity
  - Saturation handling



J1 VIIRS DNB changes



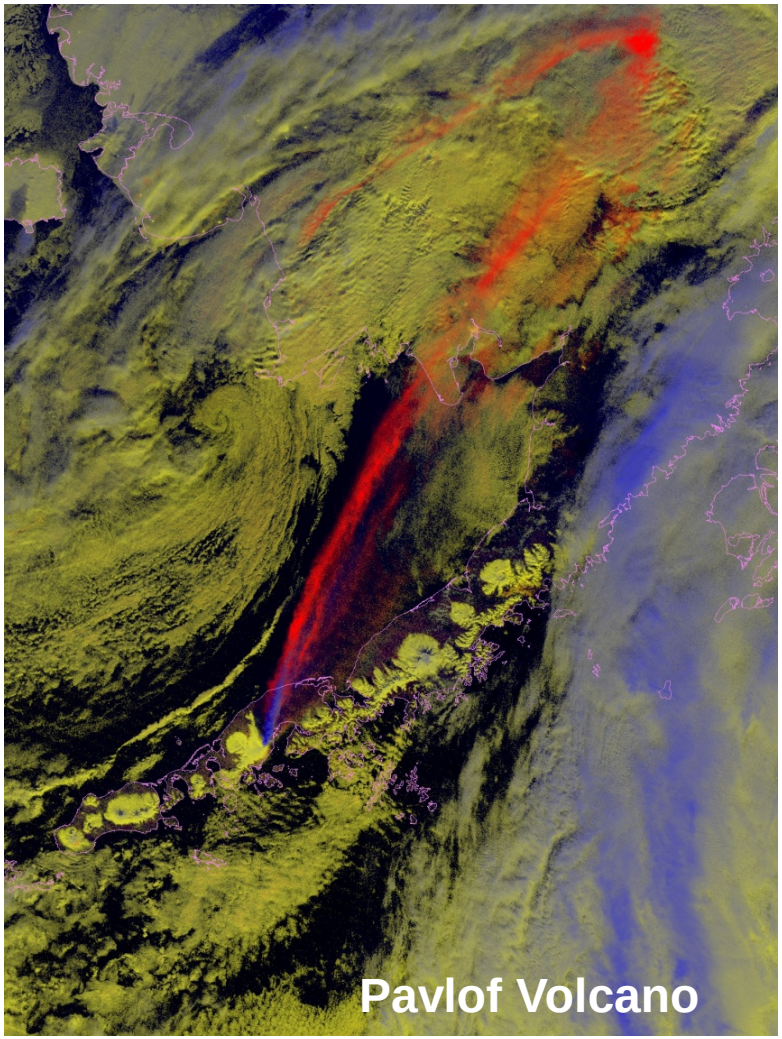
Extended DNB geolocation validation capability

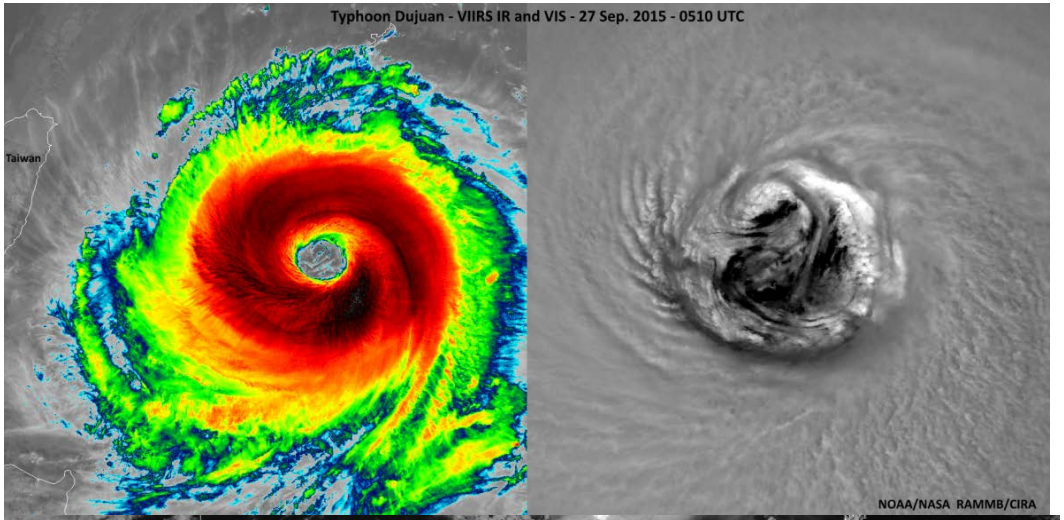
Tues. Session 3

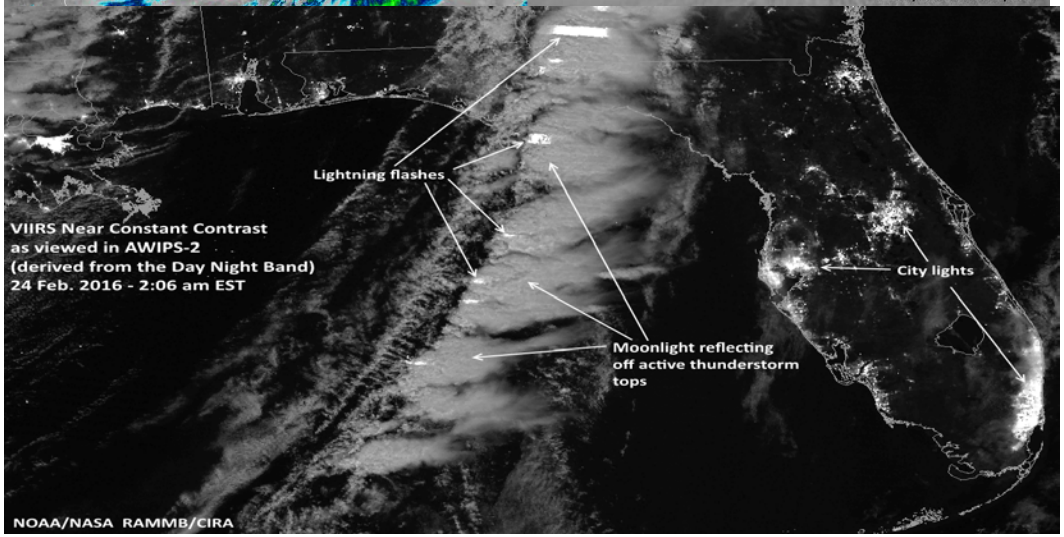
VIIRS Imagery EDR

Imagery EDR Lead: Don Hillger

Various VIIRS Imagery examples, depicting details in cloud formations or on the ground which were not seen with other instrumentation.



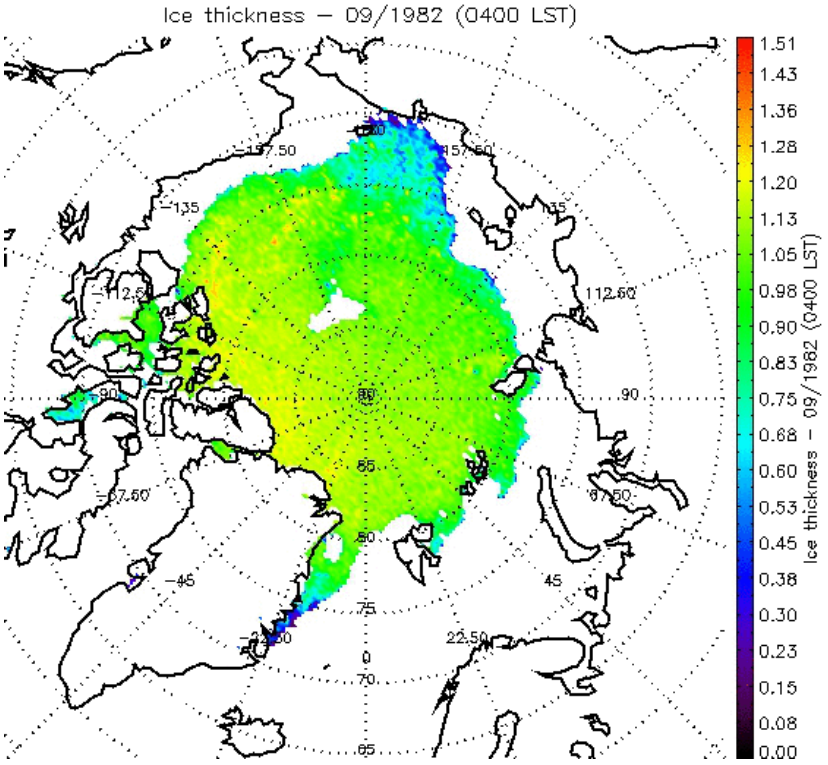


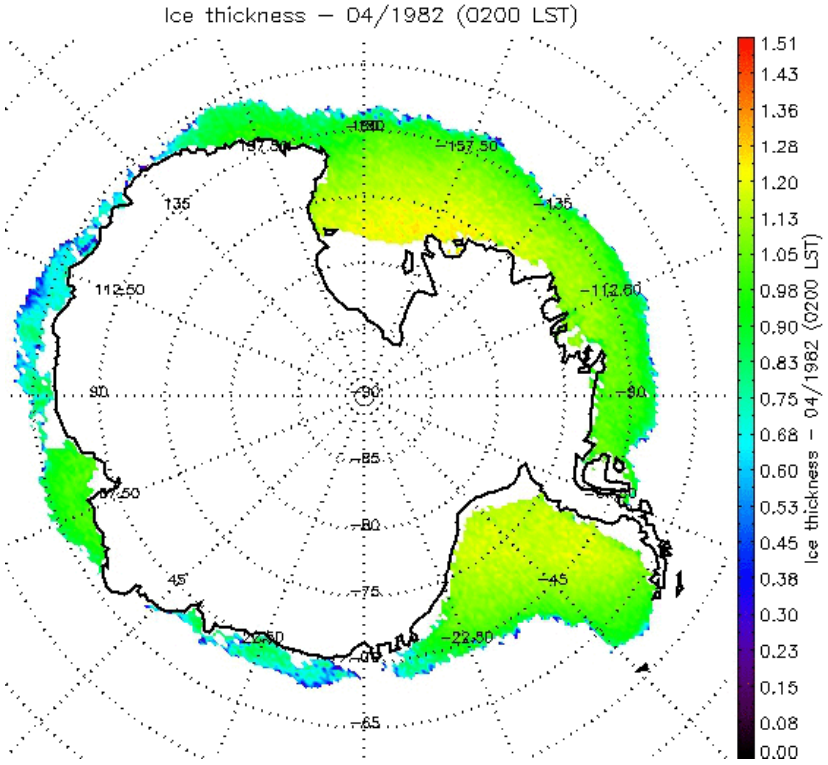


Wed. Session 8

The Enterprise VIIRS Ice Thickness Algorithm Applied to More than 30 years of AVHRR Data

Cryosphere EDR Lead: Jeff Key





Thur. Session 9 – Land and Cryosphere; Session10 – SST
Wed. Session 7 – Ocean Color; Session 8: Aerosols, Clouds, Imagery

J1 Cal Val Plans: Ensure SDRs/KPPs Operational Readiness L+90

OMPS Critical Cal/Val PLT Activities

OMPS SDR Leads Fuzhong Weng, Chunhui Pan

Launch

JPSS-1 Launch

Activation: Boot-Up → SafeHold → Decon

- Begin Housekeeping & TLM Trending

9

Aliveness & Functional Tests

11

Door Closed Phase
Spacecraft Outgassing

Default Activity: Dark Cals:

- Dark Cal Trending,
- Thermal Behavior
- Transient Detection
- Pixel Statistics, SAA, etc.

Frequent LED Cals: Linearity Trending

Pre-Tests: Low-. Med- & Hi-Res EV

42

Diffuser Wheel Opening

Door Open Phase
Intensive Cal/Val

First Ozone Measurements

Algorithm reach beta maturity (L+68)

Routine Door Open Dark Cals

NM Geo-Location Tests

EV Dynamic Range Tests

Unbinned, Full-Frame EV

EV Co-Location Tests

Day-1 Solar Cals w/Spacecraft Mnvr

Wavelength Registrtion Trending

Solar Cals at Min/Max Gon. SolarAz

EV ST/Data Rate Optimization

Noise Characterization

4-Week Cal Cycle Trending

Weekly Door Closed Dark Cals

LED Cals every 4-Weeks

Bi-Weekly Solar Cals: Working Diffuser

Storage Region Light-Leak Tests

Operational

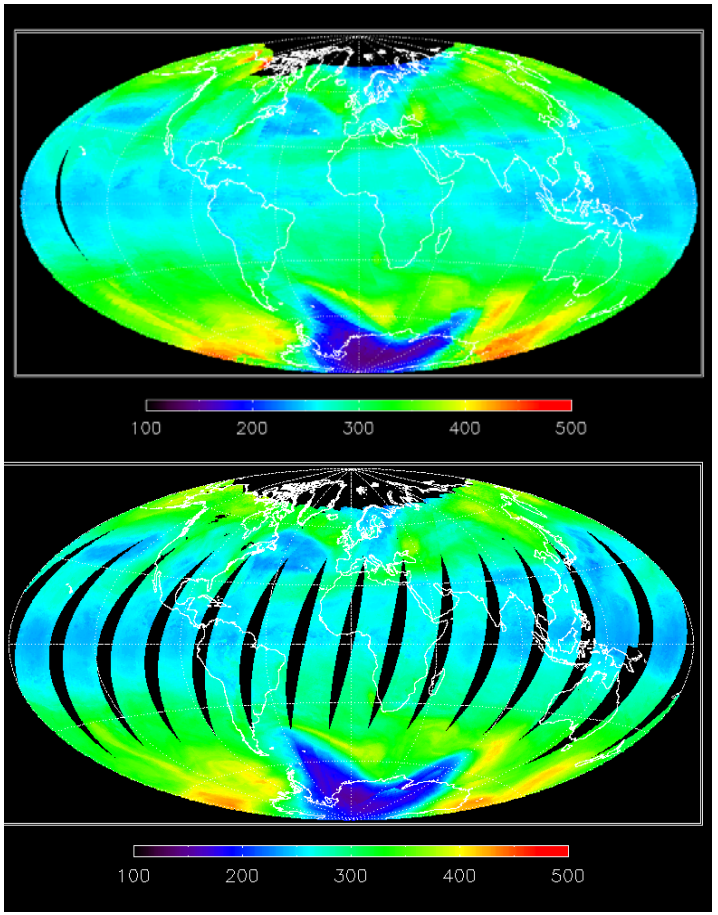
85

Operational Acceptance Review (OAR)

Algorithm reach provisional maturity (L+90)

90

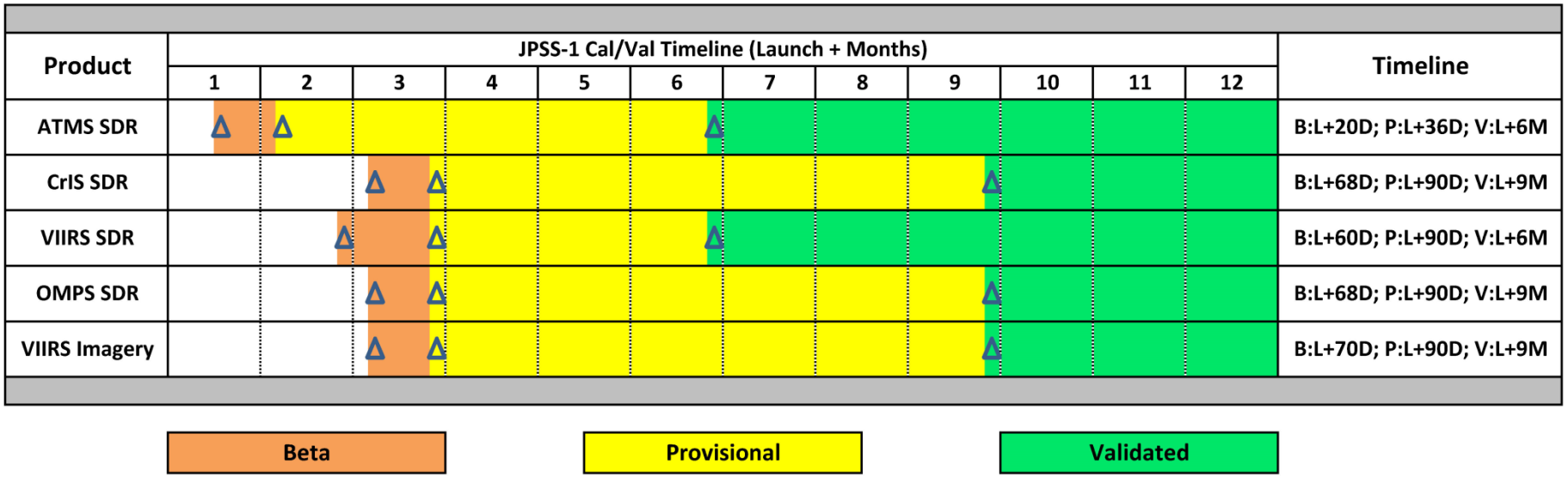
Operational Handover



Comparisons among Total Column Ozone Products from MetOp-B GOME-2 (NOAA Version 8 algorithm), and S-NPP OMPS-NM (NOAA Version 8 algorithm) for November 2, 2014 (L Flynn).

Tue. Session 5

JPSS-1 Key Performance Parameters (KPPs)
Nominal Cal/Val Timeline

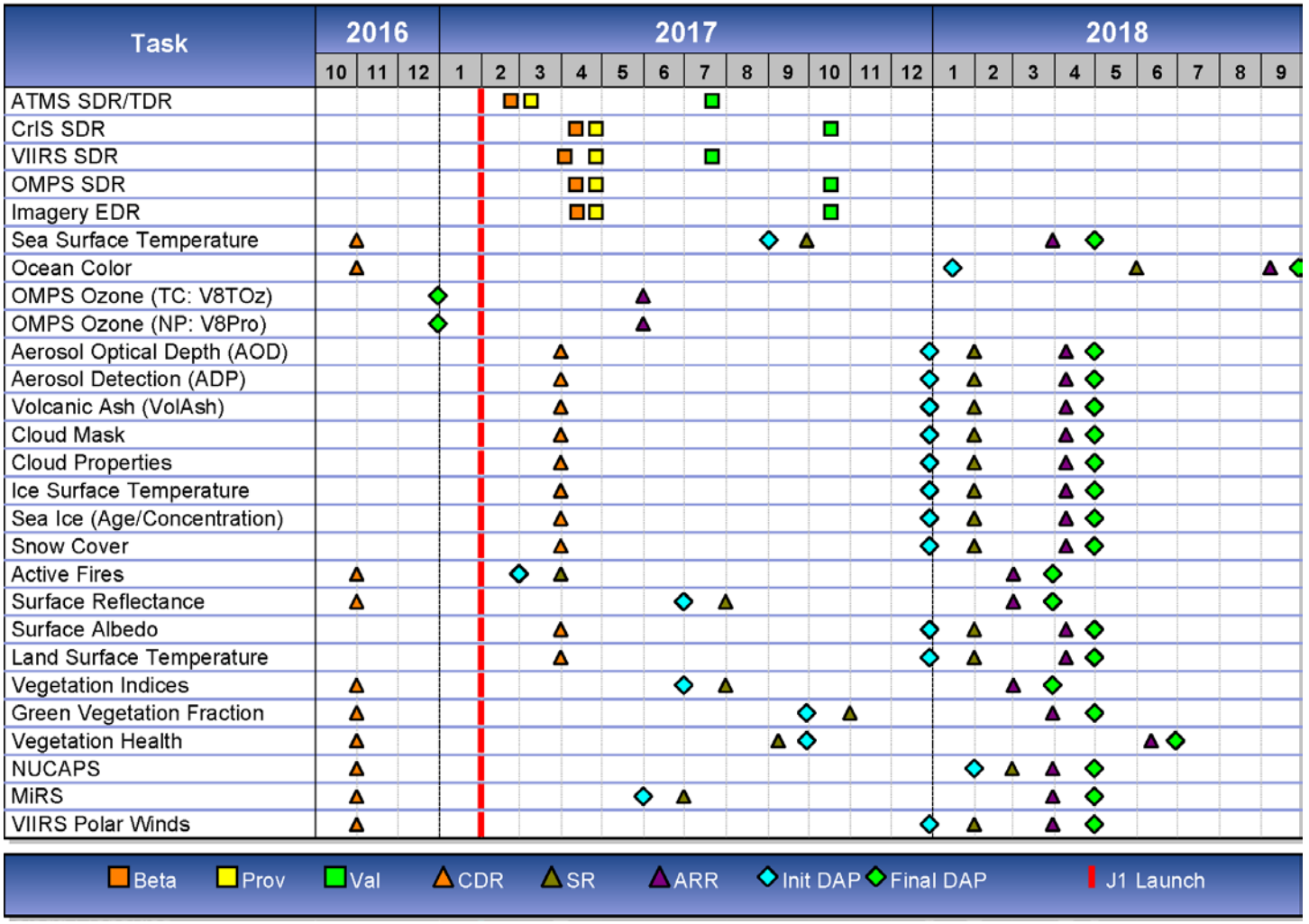


The Cal/Val activities for JPSS-1 are expected to be much more accelerated than those for S-NPP.

JPSS-1 data products will be provided to decision makers/users with a much-improved latency.

JPSS-1 Schedule

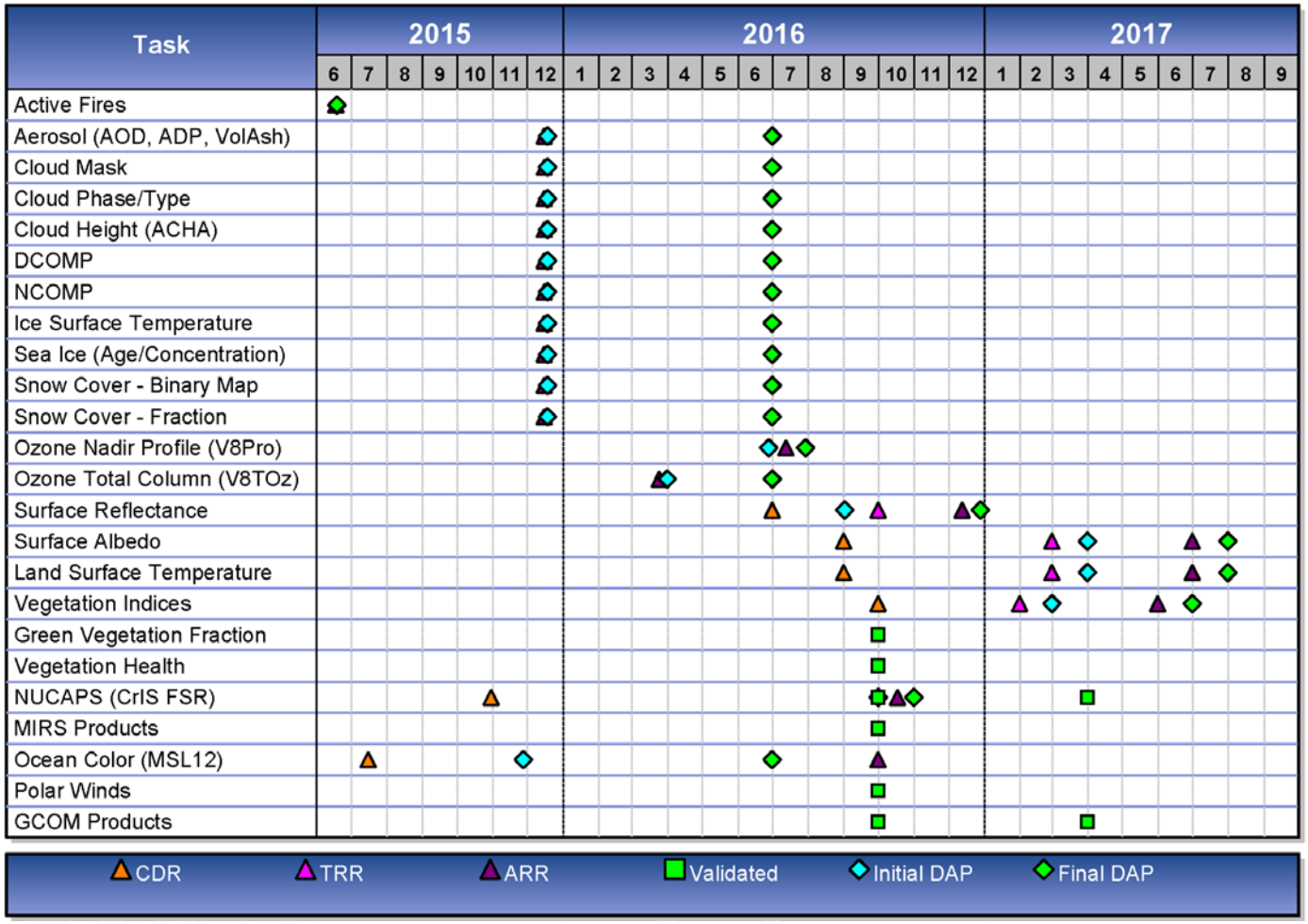
STAR JPSS Schedule: JPSS-1 Milestones



1. Beta/Provisional/Validated Cal/Val timeline is based on the JPSS-1 Launch Date Jan-2017
2. NUP Products Cal/Val Timeline will be added after receive the final Cal/Val plans

S-NPP Schedule

Enterprise Algorithm Schedule: S-NPP Milestones



1. Validated Maturity: Sep-2014, Aerosol, Clouds, Cryosphere, and Land Products; Mar-2015, Ocean Color
2. NUCAPS NUP Validated Maturity: Sep-2016, OLR & Ozone; Mar-2017, Trace Gases (CO, CO_2, & CH_4)
3. GCOM Validated Maturity Review: Sep-2016, Day-1 Products; Mar-2017, Day-2 Products

Summary

- ✓ Most of the operational S-NPP data products have reached the Validated maturity level and are currently in long-term monitoring and reactive maintenance phase.
- ✓ Replacement and upgrade of current S-NPP algorithms with NOAA enterprise algorithms and science reprocessing are ongoing.
- ✓ Closely engage with the JPSS-1 launch readiness testing activities, running the JPSS-1 testing data through the SDR and EDR algorithms, as well as long term monitoring system.
- ✓ With improved knowledge of the pre-launch characterization of the J1 instruments and by leveraging the S-NPP Cal/Val experience, the Cal/Val activities for JPSS-1 are well planned and expected to be much more accelerated

STAR JPSS 2016 Science Meeting
List of Sessions

	Monday August 8	Tuesday August 9			Wednesday August 10			Thursday August 11				Friday August 23
		Session 3:	Session 4:	Session 5:	Session 6:	Session 7:	Session 8:	Session 9:	Session 10:	Session 11:	Session 12:	
830 - 1000		VIIRS SDR (Aud)	ATMS + CrIS (Conf)	OMPS + Ozone (ESSIC)	Soundings (Aud)	Ocean Color (Conf)	Atmosphere (Aerosols, Clouds, Imagery) (ESSIC)	Land + Cryo (Aud)	SST (Conf)	Trace Gases (Sounders + OMPS) (Rm 2552)	GSICS (ESSIC)	Session 13: Users' Impacts (Aud)
		Break			Break			Break				Break
1030 - 1200		VIIRS SDR (Aud)	ATMS + CrIS (Conf)	OMPS + Ozone (ESSIC)	Soundings (Aud)	Ocean Color (Conf)	Atmosphere (ESSIC)	Land + Cryo (Aud)	SST (Conf)	Trace Gases (Sounders + OMPS) (Rm 2552)	GSICS (ESSIC)	Session 14: Wrap Up (Aud)
1200 - 1315		Lunch			Lunch			Lunch				
1315 - 1445	Session 1: Welcome & Opening Remarks (Aud)	VIIRS SDR (Aud)	ATMS + CrIS (Conf)	OMPS + Ozone (ESSIC)	Soundings (Aud)	Ocean Color (Conf)	Atmosphere (ESSIC)	Land + Cryo (Aud)	SST (Conf)	Trace Gases (Sounders + OMPS) (Rm 2552)	GSICS (ESSIC)	
1445 - 1530	Break	Poster 1			Poster 2			Poster 3				
1530 - 1700	Session 2: J1 Readiness (Aud)	VIIRS SDR (Aud)	ATMS + CrIS (Conf)	OMPS + Ozone (ESSIC)	Soundings (Aud)	Ocean Color (Conf)	Atmosphere (ESSIC)	Land + Cryo (Aud)	SST (Conf)	Trace Gases (Sounders + OMPS) (Rm 2552)	GSICS (ESSIC)	

Aud = NCWCP Auditorium **Rm 2552** = NCWCP Conference Room 2552-2553 (inside security perimeter) **Conf** = NCWCP Conference Center **ESSIC** = 5825 University Research Ct., Rm. 4102

http://www.star.nesdis.noaa.gov/star/meeting_2016JPSSAnnual_agenda.php

Thank You and Enjoy the Meeting!